INVERTIS
UNIVERSITY BAREILLY

Scheme of Instructions & Syllabi
of

Bachelor of Computer Applications
(2023-26)

With the collaboration of
CSED
(Center for Skill and Entrepreneurship Development)
[As per CBCS guidelines given by UGC]

Total Credit of the Program						
Semester	I	II	III	IV	V	VI	Total
Credits	24	24	24	28	20	22	**142**

Faculty of Computer Applications
INVERTIS UNIVERSITY
Bareilly-243123 U.P.

STUDY AND EVALUATION SCHEME
Bachelor of Computer Applications
(2023-2026)

SEMESTER I, YEAR I

Course Code	Course Title	Course Category	L+T+P	CA	EE	Total	Credit
BCA101	Environment & Ecology	AECC1	2+0+0	15	35	50	2
BCA105	Digital Electronics and Computer Organization	CC1	5+1+0	50	100	150	6
BCA106	Information Technologies	CC2	3+1+0	30	70	100	4
BCA107	C Programming	CC3	3+1+0	30	70	100	4
IIOT1	Fundamentals of IOT Development	SEC1	3+1+0	30	70	100	4
PRACTICAL / PROJECTS							
BCA154	Information Technologies Lab	CC2(P)	0+0+4	15	35	50	2
BCA155	C Programming Lab	CC3(P)	0+0+4	15	35	50	2
TOTAL			**16+4+8**	**185**	**415**	**600**	**24**

*BCA198: Qualifying Paper only for those students who are from Non-Mathematics background

Course Code	Course Title	Course Category	L+T+P	CA	EE	Total	Credit
BCA*	GE *(Qualifying)*	GE1	3+1+0	30	70	100	0

Ability-Enhancement Compulsory Course (AECC) 1 LIST			
S.No	**Code**	**AECC LIST**	**Subject Name**
1	BCA101	AECC1	Environment & Ecology

*Generic Elective Courses (GE)- 1 List			
S.No	**Code**	**GE LIST**	**Subject Name**
1	BCA198*	GE1	Remedial Mathematics

STUDY AND EVALUATION SCHEME
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SEMESTER II, YEAR I

Course Code	Course Title	Course Category	L+T+P	CA	EE	Total	Credit
BCA202	Introduction to Operating Systems	CC4	5+1+0	50	100	150	6
BCA211	Python Programming	CC5	3+1+0	30	70	100	4
BCA212	Data Structures	CC6	3+1+0	30	70	100	4
BCA**	GE	GE2	1+1+0	15	35	50	2
IIOT2	Industrial Communication Protocols & Connectivity	SEC2	3+1+0	30	70	100	4
PRACTICAL / PROJECTS							
BCA255	Python Programming Lab	CC5(P)	0+0+4	15	35	50	2
BCA256	Data Structures Lab	CC6(P)	0+0+4	15	35	50	2
TOTAL			**15+5+8**	**185**	**415**	**600**	**24**

** Generic Elective Course (GE) 2 List			
S.No	Code	GE LIST	Subject Name
1	BCA208	GE2	Numerical and Statistical Techniques
2	BCA210	GE2	Engineering Mathematics

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SEMESTER III, YEAR II

Course Code	Course Title	Course Category	L+T+P	CA	EE	Total	Credit
BCA302	Database Management Systems	CC7	3+1+0	30	70	100	4
BCA304	Computer Networks	CC8	5+1+0	50	100	150	6
BCA306	JAVA Programming	CC9	3+1+0	30	70	100	4
BCA311	Industrial Applications	AECC2	1+1+0	15	35	50	2
IIOT3	Introduction to Data Analytics	SEC3	3+1+0	30	70	100	4
PRACTICAL / PROJECTS							
BCA351	Database Management Systems LAB	CC7(P)	0+0+4	15	35	50	2
BCA353	JAVA Programming Lab	CC9(P)	0+0+4	15	35	50	2
TOTAL			**16+6+8**	**185**	**415**	**600**	**24**

Ability-Enhancement Compulsory Course (AECC) 2 LIST			
S.No	**Code**	**AECC LIST**	**Subject Name**
1	BCA308	AECC2	Industrial Applications

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SEMESTER IV, YEAR II

Course Code	Course Title	Course Category	L+T+P	CA	EE	Total	Credit
BCA401	Software Engineering	CC10	5+1+0	50	100	150	6
BCA406	Web Based System Development	CC11	3+1+0	30	70	100	4
BCA407	GUI using .Net Framework	CC12	3+1+0	30	70	100	4
BCA411	Cloud computing	CC13	5+1+0	50	100	150	6
IIOT4	Machine Learning	SEC4	3+1+0	30	70	100	4
PRACTICAL / PROJECTS							
BCA453	Web Based System Development Lab	CC11(P)	0+0+4	15	35	50	2
BCA454	GUI using .Net Framework Lab	CC12(P)	0+0+4	15	35	50	2
TOTAL			**19+5+8**	**220**	**480**	**700**	**28**

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SEMESTER V, YEAR III

Course Code	Course Title	Course Category	L+T+P	CA	EE	Total	Credit
BCA501	Computer Graphics and Animation	CC14	3+1+0	30	70	100	4
BCA*	DSE	DSE1	3+1+0	30	70	100	4
BCA**	GE	GE3	1+1+0	15	35	50	2
IIOT5	Deep Learning	SEC5	3+1+0	30	70	100	4
PRACTICAL / PROJECTS							
BCA556	Computer Graphics and Animation Lab	CC14 (P)	0+0+4	15	35	50	2
BCA*	DSE Lab	DSE1 (P)	0+0+4	15	35	50	2
BCA557	Summer Internship ***	AECC3	0+0+0	15	35	50	2
TOTAL			**10+4+8**	**150**	**350**	**500**	**20**

* Discipline Specific Elective (DSE) 1 List			
S.No	**Code**	**DSE**	**Subject Name**
1	BCA512	DSE1	DIP with MATLAB
2	BCA513	DSE1	Artificial Intelligence
3	BCA514	DSE1	Unix and Shell Programming
4	BCA515	DSE1	PHP
5	BCA516	DSE1	Advanced Java
6	BCA563	DSE1 LAB	DIP Lab
7	BCA564	DSE1 LAB	Artificial Intelligence Lab
8	BCA565	DSE1 LAB	Unix Lab
9	BCA566	DSE1 LAB	PHP Lab
10	BCA567	DSE1 LAB	Advanced Java

** Generic Elective Course (GE) 3 List			
S.No	**Code**	**GE LIST**	**Subject Name**
1	BCA508	GE3	Cyber Ethics
2	BCA509	GE3	Digital Marketing

Ability-Enhancement Compulsory Course (AECC) 3 LIST			
S.No	**Code**	**AECC LIST**	**Subject Name**
1	BCA557	AECC3	Summer Internship

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SEMESTER VI, YEAR III

Course Code	Course Title	Course Category	L+T+P	CA	EE	Total	Credit
BCA604	Advanced SQL Programming	CC15	3+1+0	30	70	100	4
GE**	GE	GE4	1+1+0	15	35	50	2
BCA*	DSE	DSE2	5+1+0	50	100	150	6
IIOT6	Advance Artificial Intelligence	SEC6	3+1+0	30	70	100	4
PRACTICAL / PROJECTS							
BCA654	Advanced SQL Programming Lab	CC15(P)	0+0+4	15	35	50	2
BCA*	DSE3	DSE	0+0+8	30	70	100	4
TOTAL			12+4+12	170	380	550	22

** Generic Elective Course (GE) 5 List			
S.No	**Code**	**GE LIST**	**Subject Name**
1	BCA611	GE4	Mobile Computing
2	BCA612	GE4	Software Project Management

* Discipline Specific Elective (DSE) 2 List			
S.No	**Code**	**DSE**	**Subject Name**
1	BCA613	DSE2	Artificial Neural Network
2	BCA614	DSE2	E-Business with Security Issue
3	BCA615	DSE2	Data and Network Security

* Discipline Specific Elective (DSE) 3 List			
S.No	**Code**	**DSE**	**Subject Name**
1	BCA664	DSE3	Project

Skill-Enhancement Elective Courses (SEC) LIST			
S.No	Code	SEC LIST	Subject Name
1	IIOT1	SEC1	Fundamental of IOT Development
2	IIOT2	SEC2	Industrial Communication Protocols & Connectivity
3	IIOT3	SEC3	Introduction to Data Analytics
4	IIOT4	SEC4	Machine Learning
5	IIOT5	SEC5	Deep Learning
6	IIOT6	SEC6	Advance Artificial Intelligence

*   Students can choose Elective from the DSE list

**   Student can choose Elective from the GE list

***   After 4th Semester, students will undergo 4 weeks' summer training compulsorily in Public Sector undertakings or Private Sector, known as Industrial Training/Internship. 50 marks will be on the basis of viva of students on their Project experience in 5th Semester.

PROGRAM OUTCOMES(POs)

		Program Outcomes (POs)
PO1	**Engineering knowledge**	Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2	**Problem analysis**	Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3	**Design/devel opment of solutions**	Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety and the cultural, societal, and environmental considerations.
PO4	**Conduct investigations of complex problems**	Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5	**Modern tool usage**	Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO6	**The engineer and society**	Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7	**Environment and sustainability**	Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8	**Ethics**	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9	**Individual and team work**	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	**Communicati on**	Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11	**Project management and finance**	Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12	**Life-long learning**	Recognize the need for, and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.

BCA101: Environment & Ecology

Teaching Scheme	Examination Scheme
Lectures: 2 hrs/Week	Class Test -12 Marks
Tutorials: 0 hr/Week	Teachers Assessment – 6 Marks
	Attendance – 12 Marks
Credits: 2	End Semester Exam – 35 marks

Prerequisite: - General knowledge of Ecology and Environment Biotechnology

Course Objectives:

1. To give an overview of Environment and factors associated with it.
2. To give basic knowledge of Effects of human activities on environment-Agriculture, Housing, Industry, Mining and Transportation activities
3. To have an overview of Natural Resources- Water Resources- Availability and Quality aspects.
4. To explain about the Environmental Pollution, their types and their effects.
5. To explain the Current Environmental Issues of Importance
6. To explain the Human Health & Hygiene: Population and birth control, sexually transmitted diseases

Detailed Syllabus

UNIT-1
 Introduction- Definition, Scope & Importance, Need for Public Awareness- Environment definition, Eco system Balanced ecosystem, Human activities – Food, Shelter, Economic and social Security. Effects of human activities on environment-Agriculture, Housing, Industry, Mining and Transportation activities, Basics of Environmental Impact Assessment.

UNIT-2
 Natural Resources- Water Resources- Availability and Quality aspects. Water borne diseases, Water induced diseases, Fluoride problem in drinking water. Mineral Resources, Forest Wealth, Material cycles- Carbon, Nitrogen and Sulphur Cycles. Energy – Different types of energy, Electro-magnetic radiation. Conventional and Non-Conventional sources – Hydro Electric, Fossil Fuel based, Nuclear, Solar, Biomass and Bio-gas. Hydrogen as an alternative future source of Energy.

UNIT-3
 Environmental Pollution and their effects- Water pollution, Land pollution. Noise pollution, Public Health aspects, Air Pollution, Solid waste management. Current Environmental Issues of Importance: Population Growth, Climate Change and Global warming- Effects, Urbanization, Automobile pollution. Acid Rain, Ozone Layer depletion, Animal Husbandry. Environmental Protection- Role of Government, Legal aspects, Initiatives by Non-governmental Organizations (NGO), Environmental Education, Women Education.

Text and Reference Books

1. Benny Joseph – "Environmental Studies" –Tata McgrawHill-2005
2. Dr. D.L. Manjunath, "Environmental Studies" –Pearson Education-2006.
3. R. Rajagopalan – "Environmental studies" –Oxford Publication – 2005.
4. M. Anji Reddy – "Text book of Environmental Science & Technology" –BS Publication. .

Course Outcomes:

After completing the course, students will be able to:

1. Identify the factors governing the environment and their impact.
2. Current Environmental Issues and solution to curb it.
3. Initiatives taken by Government and Non-governmental Organizations (NGO)
4. Judicious use of Conventional and Non-Conventional sources
5. Legal aspects pertaining to protection of environment.

BCA105: Digital Electronics and Computer Organization

Teaching Scheme	Examination Scheme
Lectures: 5 hrs/Week	Class Test -12Marks
Tutorials: 1 hr/Week	Teachers Assessment - 6Marks Attendance – 12 Marks
Credits: 6	End Semester Exam – 100 marks

Prerequisite: Basic knowledge of Computers Fundamentals and Physics of Intermediate standard.

Course Objectives:

1. To describe various types of Number System, basic electronic components and hardware components of computer system.
2. To understand the concept of Boolean algebra, types of digital circuits, memories, addressing modes and I/O interface.
3. To solve problems related to number system conversions and calculation of binary codes.
4. To implement basic Boolean expressions using different Digital Electronic device.
5. To distinguish between types of digital circuits, addressing modes, memories and I/O interface.
6. To design digital circuits for a particular functions using basic electronic concept.

Detailed Syllabus

Unit-1 **Introduction-** Digital versus Analog Signals, Electrical versus Electronics. **Number System and Codes -** Concept of number system bases – binary, octal, decimal and hexadecimal number systems and conversion between each, BCD, Excess-3, Gray Code, and Weighted Codes.
Unit-2 **Binary Arithmetic-** Binary Addition and Subtraction. Complements and Subtraction using complements, Multiplication, Division. **Boolean Algebra-** Truth table, Boolean operators and precedence, Boolean laws, De-Morgan's Theorem, Principle of Duality, SOP and POS, Conversion from SOP to POS and vice versa, Canonical and standard forms. Reduction of expressions using Boolean laws and K-Map.
Unit-3 **Logic Gates-** Primary and Secondary Logic Gates, Designing of circuits using gates, Universal Gates, Implementation of circuits using NAND and NOR.
Unit-4 **Combinational Circuits-** Half and Full Adder, Half and Full Subtract or, CLA, Multiplexer, De-multiplexer, Encoder and Decoder. Implementation using MUX and decoder. **Sequential Circuits-** Latch, Flip-flop, Introduction to RS flip-flop, J-K flip-flop D-type flip-flop, T flip-flop.
Unit-5 **Processor Organization-** Introduction and types of CPU Organization, addressing modes, Implied Addressing Mode, Immediate Addressing Mode, Register Addressing Mode, register indirect Addressing Mode, Direct Addressing Mode, Indirect Addressing Mode, Relative Addressing Mode, index Addressing Mode, auto increment/decrement Addressing Modes. **I/O Organization -** Introduction to I/O organization, I/O interface and its need.

Unit-6
Memory Organization- Memory Hierarchy, RAM and ROM chips, SRAM, DRAM, PROM, EEPROM, Introduction of Cache Memory and Virtual Memory.

Text and Reference Book
1. Digital Logic & computer Design, M. Morris Mano, PHI, 2004.
2. Computer System Architecture, M. Morris Mano, PHI, 2004.
3. Computer Organization & Architecture, W. Stallings, PHI, 6th Edition.

Course Outcomes:

After completing the course, students will be able to:

1.	Differentiate between analog and digital circuits as well as electrical and electronics.
2.	Perform number system conversion.
3.	Find solution of binary arithmetic problem and understand Boolean algebra.
4.	Implement any given Boolean expression using MUX, Decoder as well as Logic Gates.
5.	Understand the concept of internal CPU architecture and addressing modes.
6.	Understand the concept of I/O interface.
7.	Discrimination among various kind of memory devices with their need.

BCA106: Information Technologies

Teaching Scheme	Examination Scheme
Lectures: 3 hrs/Week	Class Test -12Marks
Tutorials: 1 hr/Week	Teachers Assessment - 6Marks Attendance – 12 Marks
Credits: 4	End Semester Exam – 70 marks

Prerequisite: - Fundamentals of computers

Course Objectives:
1. To know the basic components of computer and its working, generations of computer, types.
2. To know the basic input output devices.
3. To gain knowledge about Software and types
4. To describe various application software available with Microsoft Office Package with their applications.
5. To understand the importance of Microsoft Word, Microsoft Excel, Microsoft Power Point, Microsoft Access and HTML.
6. To know about various menus and tool box available with software of Microsoft Office Package and their usage to design well formatted documents, worksheets and presentations.

Detailed Syllabus

Unit-1
Computer fundamentals: Computer system concepts, Types of computers, Generations of computers, Basic components of a computer system - Control unit, ALU, Input/output functions and characteristics, Input /Output devices, Primary and Secondary memories.

Unit-2
Computer Languages: Computer Programming Languages – Machine Language, Assembly Language, High Level Language, 4 GL, their merits and demerits.
Computer software: Software and its Need, Types of Software - System software, Application software, System Software: Operating System, Utility Program, Assemblers, Compilers and Interpreter.

Unit-3
Programming Fundamentals: Algorithm development, Techniques of problem solving. Flowcharting, Structured programming concepts; Top down Design, Debugging and testing of Programs.
Introduction to HTML5 and Web Design: Create a Simple Web Page, Format Your Text, Adding Web Links and Images, Creating Tables, Forms, Borders, Backgrounds, Adding Videos and Graphics.

Unit-4
Introduction of Ms-Office: Applications of Ms-Word, PowerPoint, Excel and Access, Microsoft Word Formatting Text, Find and Replace, working with Paragraphs, Inserting Tables, Performing Calculations in Tables, Formatting Tables, Inserting Pictures, Document Background, Page Layout, Printing Documents, Mail Merge, Watermark, Page border.

Unit-5
Microsoft Excel: Creating Workbooks, Moving Data within a Workbook, Finding and Replacing Data, Perform Basic Calculations on Data, Creating Basic Formulas, Finding and Correcting Errors in Calculations, Filters, PivotTables, Creating Charts and Graphics, Printing Parts of Worksheets, Creating and Modifying Macros, Protecting Workbooks and Worksheets.

Unit-6

Microsoft PowerPoint: Creating a Presentation, Changing the Slide Size & Orientation, Adding, Deleting, and Rearranging Slides, Views, Text Formatting, Adding Tables, SmartArt, Charts, and Hyperlinks to Slides, Adding Movies and Sounds to a Presentation, Slide Transitions and Animations, Inserting Charts, Drawing Shapes. Microsoft Access: Working in Access, Database Concepts, Exploring Tables, Forms, Queries, Reports, Creating Databases from Templates, Creating Databases and Tables Manually, Manipulating Table Columns and Rows, Refining Table Structure, Creating Forms.

Text and Reference Book

1. Rajaraman V. Fundamental of Computers.
2. Ram B. Computer Fundamentals, New Age International.
3. Balaguruswamy - Programming in C.
4. Office 2007 All-in-One Desk Reference for Dummies, Wiley, 2007.
5.Microsoft Office Home and Student 2010, Microsoft Press, 2010.

Course Outcomes:

After completing the course, students will be able to:

1. Demonstrate the knowledge of the basic structure, components, features and generations of computers.
2. Apply formulae to design workbook by Microsoft Excel.
3. Create good presentations by using Microsoft Power Point.
4. Use different data structures and create / manipulate basic data files and developing applications for real world problems.
5. Create database by using Microsoft Access and applying query to fetch desired results. Create well-formed web-pages.

BCA107: C Programming

Teaching Scheme	Examination Scheme
Lectures: 3 hrs/Week	Class Test -12 Marks
Tutorials: 1 hr/Week	Teachers Assessment – 6 Marks Attendance – 12 Marks
Credits: 4	End Semester Exam – 70 marks

Prerequisite: Boolean Algebra, Number System and basic mathematical formulas

Course Objectives:
1. To develop the programming skills of students
2. To know the principles of designing structured programs
3. To write basic C programs using, control statements, loops, functions, pointers, etc.

Detailed Syllabus

UNIT I (8 Hours)
Introduction & Basic Concepts of 'C' Programming Language: History of 'C' Programming, Assembly & Machine Languages, Editors, Translators, Programming Rules, Algorithm, Structure of C program, C Character Set, Keywords, Identifiers, Rules to form an Identifier, Variables, Constants, and types, Comments, Data types, Operators, Precedence and Associativity, Types of problems (Sequential, Selective & Repetitive).

UNIT II (10 Hours)
Control structures & Loops: if, if-else, if-else ladder, nesting of if, break, continue, Switch statement, use of break and default with switch, goto, exit. Types of loops. Programs

UNIT III (10 Hours)
Array, Structure and Union: Introductions to Arrays, and Union. Operations on Array, Sorting (Selection, Bubble, Insertion), Searching (Linear, Binary), Multidimensional arrays, Pointers and arrays, Pointer and 2-d arrays, Pointer to an array, Array of Pointers, Dynamic memory allocation. Structure declaration, Operations on Structure, Nesting of structures, Array of structure, differentiate between array & structure, passing structure to function, passing array of structure to function, Structure pointer, Union, Basic operation on Union.

UNIT IV (10 Hours)
Functions and Macros: Function declaration, definition, calling, types of function, return statement, function calling methods, Storage Classes, Recursion. Macro, Macro Declaration, nesting of macros, Macros with argument, Differences between macro & function.

UNIT V (8 Hours)
Strings: Definition, declaration and initialization, standard library functions. Pointer and Strings, Two-Dimensional array of characters, Array of Pointers to String.

UNIT VI (10 Hours)
File Handling: File, File operations, Opening and Closing Files, File opening modes, Reading and Writing a data file, Text files v/s Binary files, Command Line Arguments (argc, argv), sprintf() & sscanf(), gets() & puts(), fgetc() & fputc(), fseek() & ftell(), Creation of user header file.

Text and Reference Books
1. Rajaraman V. Fundamental of Computers
2. Ram B. Computer Fundamentals, New Age International
3. Gottfried - Programming with C Schaum
4. Kanetkar Y. - Let us C
5. Balaguruswamy - Programming in C

Course Outcomes:

After completing the course, students will be able to:

1. Understanding the concept and recognize the basic terminology used in computer programming.
2. Write, Compile and Debug programs in C language and use different data types for writing the programs.
3. Design programs connecting decision structures, loops and functions.
4. Understand normal and abnormal combustion phenomena in SI and CI engines
5. Understand the dynamic behavior of memory by the use of pointers
6. Use different data structures and create / manipulate basic data files and developing applications for real world problems.

BCA198 (GE) : Remedial Mathematics *(Qualifying)*

Teaching Scheme	Examination Scheme
Lectures: 3 hrs/Week	Class Test -12Marks
Tutorials: 1 hr/Week	Teachers Assessment - 6Marks
	Attendance – 12 Marks
Credits: 4	End Semester Exam – 70 marks

Course Objectives:

1. Become confident in using mathematics to analyze and solve problems both in university and in real-life situations
2. Appreciate the logic and basics of mathematics
3. Enjoy mathematics and develop patience and persistence when solving problems in mathematical domain.
4. Understand and be able to use the language, symbols and notation of mathematics
5. Develop mathematical curiosity and use inductive and deductive reasoning when solving problems
6. Recognize that mathematics permeates the world around us.
7. Develop the knowledge, skills and attitudes necessary to pursue further studies in mathematics

Detailed Syllabus:

Unit I (10 hours)   **Quadratic Equations:** Quadratic equation, nature of the roots of a quadratic equation, relation between roots and coefficients, formation of a quadratic equation with given roots, solution of equations reducible to quadratic forms.
UNIT - II (10 Hours)   **Matrices:** Addition, Subtraction, Multiplication, Inverse of matrices, Simultaneous equation by matrices.
UNIT - III (10 Hours)   **System of Coordinates:** Certain co-ordinates, distance between two parts, area of triangle, locus of points, straight line, intercept form in normal.
UNIT - IV (10 Hours)   **Differential Calculus:** Definition and formulation of differential calculus, Rules of standard form of differential calculus, Chain Rule, Parametric rule.
UNIT - V (10 Hours)   **Integral Calculus:** Standard form of Integral calculus, Partial fraction of Integral, Trigonometric function of Integral calculus.
UNIT - VI (10 Hours)   **Linear Differential equations:** Linear differential equation of order greater than one with constant coefficient complimentary function, and particular Integral.

Text and Reference Books
1. A textbook of Mathematics for XI-XII Students, NCERT Publication Vol. I-IV. (Module I&II)
2. Loney, S.L "Plane Trigonometry" AITBS Publishers. (Module III)
3. Loney, S.L "The elements of coordinate geometry" AITBS Publishers. (Module II)
4. Narayan Shanti, Integral calculus, Sultan Chand & Co. (Module I & II)
5. Prasad Gorakh Text book on differential calculus, Pothishala Pvt. Ltd., Allahabad. (Module II)

Course Outcomes:

After completing the course, students will be able to:

1**:** Students will simplify and evaluate the concept and problems of quadratic equation.
2**:** Students will form and solve matrix problems also their real-world implementation.
3**:** Students will understand the concepts of differentiation and their real-world applications.
4**:** Students will form differential equations with the help of integration also their advancement in application.
5**:** Students will form use of vector and scalar also the concept of gradient, divergent and curl solving etc.
6**:** Students will understand the basics of coordinate and curve like circle, parabola, ellipse, hyperbola

Program Name- **INTRODUCTION TO IOT FOUNDATION**
Program Hours- **50**
Tentative Credit- **4**

OBJECTIVES
- To learn the concepts of IOT.
- To identify the different technology.
- To learn different applications in IOT.
- To learn different protocols used in IOT.
- To learn the concepts of smart systems with development in IOT.
- To learn how to visualize the real time data in IOT.

OUTCOMES
- Project oriented learning with real time applications.
- End – to – end learning & development with different technologies of IOT System.
- Apply IOT to different applications using Thingworx.
- Application and analysis of protocols used in IOT.
- Design and develop smart things in IIOT using Thingworx.
- Analysis and evaluation of the data received through sensors in IOT using different visualization techniques.

SCOPE
- IIOT Designer
- IIOT Developer
- IIOT Analyst
- IIOT Tester
- Entrepreneurship

PROJECTS
- Smart Home Automation
- Smart washroom
- Smart Kitchen
- Smart Dustbin
- Smart Smoke Detector
- Smart Irrigation
- Smart Street Light
- Thingworx app development

INTRODUCTION TO IOT FOUNDATION

Module 1:

Programming of Microcontroller: Problem Statement Understanding, Tinker CAD Introduction, Simulation with LEDs & Serial Monitor, Introduction Sensors, Development board and Different Actuators, Basic Electronics Components of IOT, Basic Arduino Programs with Sensors & Actuators, Interfacing LED, Interfacing LCD, Installing Board Packages, Serial Monitor and Debugging Tool, Installing Sensor Libraries.

Module 2:

Embedded coding and Debugging of Microcontroller: Hardware Selection, Interfacing with Development Board, Coding & Testing, Architecture of Microcontroller, Analog & Digital Signals, Basic gates, Timers, Counters, flipflops, Registers, RAM, and ROM (PROMS, EPROMS, EEPROMS), Multiplexers, De-Multiplexers, Encoders, Decoders.

Module 3:

IOT Communication Protocols– IOT Communication Protocols, Wired Protocols Introduction to (Ethernet: Twisted pair, Co-axial cables, Optical Fiber), Wireless Protocols Introduction to (Wi-Fi, Bluetooth, Zigbee, RFID, LoRa), Networking Protocols (OSI Model, TCP/IP, Ethernet), Network Architecture, protocols, and serial monitoring.

Module 4:

Interfacing of Sensors: Interfacing Ultrasonic Sensors, Interfacing Temperature Sensor, Interfacing PIR Sensors, Interfacing MQ Sensors, Interfacing Servo Motor, Interfacing Soil Moisture Sensor, Interfacing Photo Sensor.

Module 5:

IoT Web Application Development in Thingworx: Experiencing IoT Application, Thingworx Composer, Creating Thing, Thing Template, Creating Properties, Creating Alerts, Creating Subscription, Building Mashups, Mapping Thing Model to Mashup, Application Keys, Thingworx REST API, ESP32-GPIO and Environment, Wi-Fi (802.11) Interfacing.

Reference Books & Materials:

- The Internet of Things (The MIT Press Essential Knowledge series) by Samuel Greengard
- The Fourth Industrial Revolution Paperback – by Klaus Schwab
- Introduction to Arduino
- Programming with Arduino
- Getting to Know Thingworx Platform

BCA202: Introduction to Operating Systems	
Teaching Scheme	**Examination Scheme**
Lectures: 5 hrs/Week	Class Test -20Marks
Tutorials: 1 hr/Week	Teachers Assessment - 10Marks Attendance – 20 Marks
Credits: 6	End Semester Exam – 100 marks

Prerequisite: - Programming languages, Data Structures, Microprocessor peripherals and interfacing

Course Objectives:

1. Define and list the functions of an operating system.
2. list resources involved in process creation and management.
3. Explain the use of paging and segmentation
4. Explain the function and structure of the I/O system.
5. Describe path names and directory structure visible to end users

Detailed Syllabus:

Unit-1
Introduction: Operating System, Simple Batch Systems, Multi programmed Batched Systems, Timesharing Systems, Real-Time Systems, System Components, Operating System Services & Functions.

Unit-2
Process: Process Concept, Process Scheduling, CPU Scheduling: Basic Concepts, Scheduling Criteria, Scheduling Algorithms with examples.

Unit-3
Process Communication and Synchronization: Co-operating Process, Inter-process communication, Threads (Thread Concept, Single and Multiple Threads, Benefits). Introduction to process synchronization, Critical Section Problem.

Unit-4
Deadlock: Deadlock Introduction, Deadlock Characterization, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, and Recovery from Deadlock.

Unit-5
Memory Management: Logical versus Physical Address Space, Swapping, Contiguous Allocation (Memory Allocation, Fragmentation), Paging (Basic Method, Hardware Support), Segmentation (Basic Method, Hardware). **Virtual Memory:** Demand Paging, Page Replacement, Page Replacement Algorithms.

Unit-6
File System: File Concept, Access Methods, Directory Structure, File System Structure, Allocation Methods, Free-Space Management, Protection of File System. Input/output Management. Linux Case Study.

Text and Reference Books
1. Operating System concepts, A. Silberschatz, Peter B. Galvin, Addison Wesley publishing Company, 6th Edition.
2. Operating System Concepts & Design, MilenKovic, TMH publication, 2001.
3. Operating System Concepts, Sibsankar, Halder, Pearson Education, 2009.
4. Operating Systems, Deitel H.M, Addison Wesley, 2nd Edition.
5. Operating Systems, Stalling W, Prentice Hall, 4th Edition.
6. Operating System Concepts, Tanenbaum, Prentice Hall, 3rd.

Course Outcomes:

After completing the course, students will be able to:

1. Differentiate between multiprocessing, multiprogramming, and multitasking.
2. Differentiate between programs, processes and threads.
3. Apply segmentation and paging techniques.
4. Compare file naming in Linux and Windows.
5. Awareness of various Operating System

BCA211: Python Programming

Teaching Scheme	Examination Scheme
Lectures: 3 hrs/Week	Class Test -12Marks
Tutorials: 1 hr/Week	Teachers Assessment - 6Marks Attendance – 12 Marks
Credits: 4	End Semester Exam – 70 marks

Course Objectives:

1. To give knowledge about python programming.
2. To introduce python development language.
3. To give knowledge about concept of python.
4. To explore the skills of web programming using python.

Detailed Syllabus

Unit-1
Introduction to Python: Importance of Python, Installing and working with Python in Windows, Linux and Mac, Using Python as calculator, Comments, how to define main function in Python
The concept of data types - Variables, Arithmetic Operators and Expressions.

Unit-2
Subscript Operator, Indexing, Slicing a string, Converting strings to numbers and vice versa, split function
Control flow - if statements, for and while loops, nested loops, Short-circuit (lazy evaluation), range() function, break and continue statements, pass statements.

Unit-3
Data Structures: **Lists** - Basic list operations, Replacing, inserting, removing an element; Searching and sorting a list, Methods of list objects, using lists as Stacks and Queues, how efficient lists are when used as stack or queue, List and nested list Comprehensions Tuple, Sets, Difference between list and tuple, **Dictionary** - adding and removing keys, accessing and replacing values, traversing dictionaries

Unit-4
Python functions and modules - OS and SYS modules, defining python functions, calling a function, function arguments, Lambda and map function, Importing python module.
Useful Python Packages – Beautiful Soup, NumPy, iPython, tkinter
Classes and OOP - Class definition syntax, objects, class and instance variables, Inheritance and multiple inheritance, Polymorphism, Overloading, Overriding, Data Hiding.

Unit-5
Regular Expressions - re module, Searching a string (match and search), Finding a string (findall), Break string into substrings (split), Replace part of a string (sub)
Examples of Regex - Return the first word of a given string, Extract all the words of a given string, Extract domain name from given e-mail id's, Extract date from given string, Return all the words of a string that starts with vowel, Split a string with multiple delimiters, Retrieve some information from HTML or XML file.

Unit-6
File Handling - Reading keyboard input, opening and closing file, Read, Write and Append mode, Create and Read a text file, Looping over a file object, Writing on a file, with statements, splitting lines in a text file, Renaming and Deleting files, **Exception Handling** - Exceptions, Why use exceptions, Raising an exception, try and except, try, except and else clause; try and finally

Text and Reference Books
1. Python Programming for the Absolute Beginner By Laila M. Dawson
2. Learn Python the Hard Way By Zed A.Shaw
3. Learning Python By Mark Putz Python Documentation (https://docs.python.org)

Course Outcomes:

After completing the course, students will be able to:

1.	Understand various types of website development using python.
2.	Analyze the latest language designing and optimize new technology.
3.	Identify benefits of using python in the fiels of latest development in machine learning, web.
4.	Understand data structure using python implementation.
5.	Data mining and data analyzing.

BCA212: Data Structures	
Teaching Scheme	**Examination Scheme**
Lectures: 3 hrs/Week	Class Test -12Marks
Tutorials: 1 hr/Week	Teachers Assessment - 6Marks Attendance – 12 Marks
Credits: 4	End Semester Exam – 70 marks

Prerequisite: -
1. Familiarity with the fundamentals of C or other programming language
2. A solid background in mathematics, including probability, set theory

Course Objectives:
1. To learn the basics of abstract data types.
2. To learn the principles of linear and nonlinear data structures.
3. To build an application using sorting and searching.

Detailed Syllabus

UNIT I (10 Hours)
Introduction Data Structure: Introduction to Data Structure, Classification of data Structure, Operation on data structure, Top down and Bottom-up approaches to algorithm, Analysis of algorithm, Frequency count, Complexity measures in terms of time and space.

UNIT II (10 Hours)
Arrays: Representation of array (single & multi-dimensional arrays), Traversing, insertion and deletion operations. Merging, matrix addition, subtraction, multiplication, transpose, sparse matrix

UNIT III (10 Hours)
Stacks: Introduction to stack, primitive operation on stack, Stacks application: Infix, post fix, Prefix and Recursion.
Queues: Introduction to queues, Primitive Operations on the Queues, Circular queue, Dequeue, Priority queue, Applications of queue.

UNIT IV (10 Hours)
Linked List: Introduction to the Linked List, Basic operations on linked list, Header nodes, Doubly Linked List, Circular Linked List, and Application of Linked List.

UNIT V (6 Hours)
Trees: Basic Terminology, Binary Trees, Tree Representations using Array & Linked List, Basic operation on Binary tree. **Traversal of binary trees:** In order, Preorder & post order, Application of Binary tree, Threaded binary tree, Heap Tree,B-tree & Height balanced tree.

UNIT VI (10 Hours)
Searching and Sorting: Sequential search & binary search, Hashing, sorting method (Insertion sort, Selection sort, Bubble sort, Quick sort, Merge sort, Heap sort).

Text and Reference Books
1. Data Structures and Program Design in C, R.L. Kruse, B.P. Leung and C. L. Tondo, PHI, 2008.
2. Data Structures, Seymour Lipscutz, Mcgraw Hill Publication, 2009
3. Data structures using C, Aaron M.Tenanbaum, Pearson education, 2004.
4. Data structure through C, Yashvant Kanetkar, BPB Publication, 2006.

Course Outcomes:

After completing the course, students will be able to:

1. Solving problems and simulate the insertion and deletion by using DS methods.
2. Understanding the concept and recognize the basic terminology used in computer programming.
3. Write, Compile and Debug programs in C language and use different data types for writing the programs.
4. Design programs connecting decision structures, loops and functions.
5. Understand the dynamic behavior of memory by the use of pointers
6. Use different data structures and create / manipulate basic data files and developing applications for real world problems.

BCA208 (GE): Numerical and Statistical Techniques

Teaching Scheme	Examination Scheme
Lectures: 1 hr/Week	Class Test -6 Marks
Tutorials: 1 hr/Week	Teachers Assessment - 3Marks
	Attendance – 6 Marks
Credits: 2	End Semester Exam – 35 marks

Prerequisite: - Elementary Mathematics

Course Objectives:

The aim is to teach the student various topics in Numerical Analysis such as solutions of nonlinear equations in one variable, interpolation and approximation, numerical differentiation and integration, direct methods for solving linear systems, numerical solution of ordinary differential equations. Numerical Techniques for finding roots, Bisection method, Newton-Raphson method, numerical integration using Simpson's rules, Newton Cote's quadrature method, solving differential equations, interpolation and extrapolation.

Detailed Syllabus

Unit-1
Transcendental and polynomial equation using Bisection method, Regula-falsi method and Newton-Raphson method.

Unit-2
Interpolation-Finite differences, difference tables, Newton's forward and backward interpolation formulae, Lagrange's and Newton's Divided difference formulae for unequal intervals.

Unit-3
Gauss's interpolation formula, Stirlling's formula, Bessel's formula, Laplace-Everett formula.

Unit-4
Numerical Differentiation and Integration, Newton- Cote's quadrature formula, Trapezoidal Rule, Simpson's $1/3^{rd}$ Rule, Simpson's $3/8^{th}$ Rule.

Text and Reference Books
1. Numerical Methods for Scientific Engineering Computation, Jain, Iyenger & Jian, New Age International , New Delhi, 2003.
2. Higher Engineering Mathematics, B.S. Grewal, Khanna Publishers, 2006.
3. Advanced Engineering Mathematics, E. Kreysig, John Wiley & Sons, 2005.
4. An Introduction to Numerical Analysis, Devi Prasad, Narosa Publication House, 3rd Edition.
5. Advanced Engineering Mathematics, R.K. Jain & S.R.K. Iyenger, Narosa Publication House, 3rd Edition.
6. Calculus of finite differences and numerical analysis, H.C. Saxena, S. Chand Publication, 1st Edition, 2005.

Course Outcomes:

After completing the course, students will be able to:

1. Demonstrate understanding of common numerical methods and how they are used to obtain approximate solutions to otherwise intractable mathematical problems.
2. Apply numerical methods to obtain approximate solutions to mathematical problems.
3. Derive numerical methods for various mathematical operations and tasks, such as interpolation, differentiation, integration, the solution of linear and nonlinear equations, and the solution of differential equations.
4. Analyze and evaluate the accuracy of common numerical methods.
5. Implement numerical methods.
6. Write efficient, well

BCA210 (GE): Engineering Mathematics

Teaching Scheme	Examination Scheme
Lectures: 1 hr/Week	Class Test -6 Marks
Tutorials: 1 hr/Week	Teachers Assessment - 3Marks Attendance – 6 Marks
Credits: 2	End Semester Exam – 35 marks

Prerequisite: - Elementary Mathematics

Course Objectives:

- To develop logical understanding of the subject.
- To develop mathematical skill so that students are able to apply mathematical methods &
- principals in solving problem from Engineering fields.
- To make aware students about the importance and symbiosis between Mathematics and
- Engineering.

Detailed Syllabus

Unit-1
Limit and Continuity Differentiability: Limit, Continuity, Differentiability of one variable for real numbers systems. Algebra of continuous functions, Continuity of composite functions. Continuity for open and closed intervals.

Unit-2
Sequences: Sequence of real number systems, Convergent, Divergent, Oscillatory sequences, Bounded sequences and theorems, Monotonic sequence, Subsequence, Limit Superior and Inferior.

Unit-3
Infinite Series: Convergence and Divergence of an infinite series, P-test series, Comparison test, D' Alembert test, Cauchy's nth root test, Raabe's test, Logarithmic test, Higher logarithmic test, De Morgan & Bertrand's test.

Unit-4
Indeterminate forms: L's Hospital Rule (without proof). Rolle's Theorem, Lagrange's Mean Value Theorem, Cauchy's Mean Value Theorem. Expansion of functions by Maclaurin's & Taylor's for single variables.

Text and Reference Books
1. Advanced Engineering Mathematics, E.Kreyszig, John Wiley & Sons, 2005.
2. Higher Engineering Mathematics, B. S. Grewal, Khanna Publishers, 2006.
3. Calculus, George B. Thomas, Ross L. Finney, Pearson Publications, 9th Edition, 1996.

Course Outcomes:

After completing the course, students will be able to:

1. To Perform matrix operations. Solve the matrix equation using elementary matrix operations. To use systems of linear equations and matrix equations to determine linear dependency or independency. To find the Eigen values and corresponding eigenvectors for a linear transformation.
2. To understand how quadratic equations, lead to complex numbers. To write complex numbers in polar form, compute exponential and integrals powers of complex numbers. To apply De-Moivre's theorem to determine roots of polynomial and can express hyperbolic, inverse hyperbolic functions.
3. To understand the convergence and divergence of infinite series and to evaluate successive differentiation.
4. To be able to write expansion of function. To evaluate the limit of a function at a point or at infinity numerically by using L-Hospital's Rule.
5. TO evaluate partial derivatives and can implement to estimate maxima and minima of multivariable function.
6. To understand the applications of partial differentiation. To estimate maxima and minima of multivariable function.

Program Name- **INDUSTRIAL COMMUNICATION PROTOCOLS & CONNECTIVITY**
Program Hours- **50**
Tentative Credit – **4**

OBJECTIVES
- Address the real-world problems and find the required solution.
- Study the various communication protocols and networking.
- Study the basic concepts of programming/ hardware/ emulator for ESP Controllers.
- Understanding the real time requirement for Smart System Development.
- Study the various server-based communication models.
- Build and test Smart Genset project successfully.
- Improve the team building, communication, and management skills of the students.

OUTCOMES
- Identify the requirements for the real-world problems.
- Building Mashup and Widgets using Thingworx.
- Study and enhance software/ hardware skills.
- Demonstrate and build the project successfully by hardware, requirements, coding, emulating, and testing.
- To report and present the findings of the study conducted in the preferred task.
- Demonstrate an ability to work in teams and manage the conduct of the research study.

SCOPE
- IIOT Designer
- IIOT Developer
- IIOT Analyst
- IIOT Tester
- Entrepreneurship

PROJECTS
- Smart Genset Monitoring System
- Thingworx App Development

INDUSTRIAL COMMUNICATION PROTOCOLS & CONNECTIVITY

Module 1:

Project Presentation – Smart GENSET.
Programming for Smart genset: Problem Statement Understanding, Hardware Selection, GPIO–ESP32, External Library Importing for Target Board, Interfacing with Development Board, Coding & Testing.

Module 2:

Peripherals Interfacing with Communication Protocol for Smart genset: On board Communication Protocol–SPI, I2C, UART, Display Sensor Data on Serial Monitor, Display Sensor Data on LCD.

Module 3:

Introduce ARM Cortex-A72 for Smart genset: OS installation on ARM, Package installation and purging, GPIO –ARM Cortex-A72 and Interfacing, File handling using Scripting.

Module 4:

Applied Python for Smart genset: Data Type, Keyword, Identifier, Conditional Statement, Iterative statement, Functions, Library Importing using PIP**.**

Module 5:

Interfacing Industrial Sensor: Interfacing Fuel Level Sensor, Interfacing Temperature Sensor, Interfacing Energy Meter Sensor, Interfacing Vibration Sensor, Interfacing Rotation Counter, Interfacing Smoke Sensor, Data Transmission.

Module 6:

Host Communication: Client and Server, ESP-Now, ESP-MESH, WebSocket's, Kepware.

Module 7:

Thingworx Composer with apps Design: Industrial Mashup Composing, Services and Alerts, Events and Subscriptions, Thingworx apps Design, Fuel Level Sensor Data on Thingworx, Temperature Sensor Data on Thingworx, Energy Meter Sensor Data on Thingworx, Vibration Sensor Data on Thingworx, Tachometer Sensor Data on Thingworx, Smoke Sensor Data on Thingworx, Self-Start Event and Alerts, Data Visualization.

Reference Books & Materials:

- Introduction and History of GENSET's
- Fundamentals of IoT Communication Technologies by Herrero Rolando
- Thingworx Design & Development
- Introduction to HTTP Protocol

BCA302: Database Management Systems

Teaching Scheme	Examination Scheme
Lectures: 3 hrs/Week	Class Test -12Marks
Tutorials: 1 hr/Week	Teachers Assessment – 6 Marks
	Attendance – 12 Marks
Credits: 4	End Semester Exam – 70 marks

Prerequisite: Computer Organization, Operating System, Data Structure, Mathematics

Course Objectives:

1. Understanding values of Data,
2. significant role of DBMS, normalizing a Database,
3. **problems with unnecessary duplication of data, transaction, concurrent transactions**

Detailed Syllabus:

Unit-1
Introduction to Database System: DBMS Definition, Characteristics of DBMS, Application and advantages of DBMS, Instances , Schemas and Database States, Three Levels of Architecture , Data Independence, DBMS languages, Data Dictionary, Database Users, Data Administrators.

Unit-2
Data Models: Data Models, types and their comparison, Entity Relationship Model, Entity Types, Entity Sets, Attributes and its types, Keys, E-R Diagram, Data Integrity, RDBMS: Concept, Components and Codd's rules.

Unit-3
Relational Databases: Introduction to Relational Databases and Terminology-Relation, Tuple, Attribute, Cardinality, Degree, Domain. Keys, Super Key, Candidate Key, Primary Key, Foreign Key, Relational Algebra. Operations, Select, Project, Union, Difference, Intersection Cartesian product, Join, Natural Join.

Unit-4
Structured Query Language (SQL): Introduction to SQL, History of SQL, Basic Structure, DDL Commands, DML Commands, TCL Commands, Simple Queries, Nested Queries, Join queries, semi-join queries, self-join. Aggregate Functions and Clauses.

Unit-5
Relational Database Design: Introduction to Relational Database Design, DBMS vs RDBMS.

Unit-6
Normalization: Anomalies of un-normalized database, Need of Normalization, Normal Forms-1NF, 2NF, 3NF, BCNF and functional dependency.

Text and Reference Books

1. 1. Database System Concepts, Henry Korth , A. Silberschatz, 5th Edition, 2005.
2. An Introduction to Database System, Bipin Desai, Galgotia Publications, 1991.
3. SQL, PL/SQL the Programming Language of Oracle, Ivan Bayross, BPB Publications, 4th Edition.
4. Schaum's Outline of "Fundamental of Relational Databases", Ramon A. Mata, Pauline K. Cushman, McGraw Hill, December, 2006.

Course Outcomes:

After completing the course, students will be able to:

1. Differentiate between multiprocessing, multiprogramming, and multitasking.
2. Differentiate between programs, processes and threads.
3. Apply segmentation and paging techniques.
4. Compare file naming in Linux and Windows.
5. Awareness of various Operating System

BCA304: Computer Networks

Teaching Scheme	Examination Scheme
Lectures: 5 hrs/Week	Class Test -20Marks
Tutorials: 1 hr/Week	Teachers Assessment - 10Marks Attendance – 20 Marks
Credits: 6	End Semester Exam – 100 marks

Prerequisite: -
1. Familiarity with the fundamentals of Digital Electronics.
2. A network simulation method.

Course Objectives:
1. Learn how computer network hardware and software operate.
2. Investigate the fundamental issues driving network design.
3. Learn about dominant network technologies.

Detailed Syllabus

Unit-1
Introduction to Computer Networks: Data Communication System and its components, Data Flow, Computer network and its goals, Types of computer networks: LAN, MAN, WAN, Network topologies, ISO-OSI reference model, TCP/IP reference model

Unit-2
Physical Layer: Concept of Analog & Digital Signal, Bandwidth, Transmission Impairments: Attenuation, Distortion, Noise, Introduction to Transmission Media: Twisted pair, Coaxial cable, Fiber optics, Wireless transmission (radio, microwave, infrared), Switching methods, integrated services digital networks

Unit-3
Medium Access sub layer: Channel Allocations, LAN protocols -ALOHA protocols, Collision free Protocols-Token Passing, IEEE standards, Ethernet and Token Ring. Data Link Layer: Framing, Error detection and correction codes: checksum, CRC, hamming code, Sliding Window Protocols: Stop & Wait ARQ, Go-back-N ARQ, Selective repeat ARQ

Unit-4
Network Layer: Point-to Point networks, Routing algorithms, Congestion control algorithms, Internetworking Devices, IP protocol, IP addresses: IPv4 classful and classless addressing, Introduction to IPv6

Unit-5
Transport Layer: Connection management: Three-way Handshaking. Introduction of User Datagram Protocol (UDP), Basics of Transmission Control Protocol. (TCP).

Unit-6
Application Layer: File Transfer Protocol, Domain Name System, Electronic mail, Intro of Client server model, Hyper Text Transfer Protocol, WWW, Example Networks - Internet and Public Networks

Text and Reference Books
1. 1. Database System Concepts, Henry Korth , A. Silberschatz, 5th Edition, 2005.
2. An Introduction to Database System, Bipin Desai, Galgotia Publications, 1991.
3. SQL, PL/SQL the Programming Language of Oracle, Ivan Bayross, BPB Publications, 4th Edition.
4. Schaum's Outline of "Fundamental of Relational Databases", Ramon A. Mata, Pauline K. Cushman, McGraw Hill, December, 2006.

Course Outcomes:

After completing the course, students will be able to:

1. Explain and demonstrate the mechanics associated with IP addressing, device interface, association between physical and logical addressing, subnetting and supernetting
2. Understand the techniques and protocols used (DSL, SONET, ATM).
3. Know the principles of congestion control and trade-offs in fairness and efficiency
4. Distinguish between analog and digital signals and understand their characteristics (Fourier representation, signal corruption).

BCA306: Java Programming

Teaching Scheme	Examination Scheme
Lectures: 4 hrs/Week	Class Test -12Marks
Lab: 4 hrs/Week	Teachers Assessment - 6Marks Attendance – 12 Marks
Credits: 4	End Semester Exam – 70 marks

Prerequisite: - C programming, Object Oriented Programming using C++

Course Objectives:
1. To describe concepts of OOPS using Java.
2. To summarize the uses of packages in Java programming.
3. To implement string and exception handling concepts using Java.
4. To analyze concepts of strings and file handling, exception handling.
5. To test significance of multithreading and socket programming.
6. To design GUI application along with the database connectivity.

Detailed Syllabus

UNIT I
Introduction: Features of the Java Language, Platform Independency, JVM, Byte-code, Operator, Data type, Variables, Robustness.
OOPS: Object, Class, Classifications, Methods & classes, Inheritance, Static and non-Static methods, Overloading, Overriding of methods, Abstraction, Interface, Polymorphism.

UNIT II
Packages: Data Encapsulation, Concept of Package, creating package, Importing packages, Child Packages.
Exception Handling: Exceptions & Errors, Types of Exception, Control Flow in Exceptions, Use of the try, catch, finally, throw, throws in Exception Handling. In-built and User Defined Exceptions, Checked and Unchecked Exceptions.

UNIT III
I/O, String Handling: Operation on String, Mutable & Immutable String, tokenizing a String, Creating Strings using String Buffer.
I/O and File Handling: Bufferedreader class, InputStreamReader class, Scanner class, Creating File, Finding File Reading and Writing File (Doc File, Html File, a Text File).
Array and Loop: Defining an Array, Initializing & Accessing Array, Multi –Dimensional Array and Control Statements.

UNIT IV (10 Hours)
Multi-Threading: Understanding Threads, Needs of Multi-Threaded Programming, Solution of Producer consumer problem by Multi Thread, Thread Life-Cycle, Thread Priorities, Synchronization of Thread.
Java Networking: Concept of client and Server, Introduction of TCP, Concept of Socket, Importance of Socket, Socket programming, communication between client and server.

UNIT V
GUI Application Development: Introduction to AWT, AWT controls Java Applet, Layout Managers, Menus, Images, Graphics, Event Handling, Swing, Containers, Panes, Frames, Dialogue boxes, working with image controls.

UNIT VI
JDBC: The connectivity Model, JDBC/ODBC Bridge, Java, SQL package, connectivity to remote database, navigating through multiple rows retrieved from a table/ multiple tables of a database.

Text and Reference Books:
1. The Complete Reference Internet, Margaret Levine Young, TMH, 1999.
2. The Complete Reference JAVA 2, Naughton Schildt, TMH, 5th Edition.
3. Programming in JAVA, E. Balagurusamy E, TMH, 3rd Edition, 2006.
4. Java Black book, Steven Helzner, Dreamtech , 2002

Course Outcomes:

After completing the course, students will be able to:

1. Understand concepts of OOPS.
2. Analyze the effect of using OOPS concepts.
3. Understand the communication between client and the server.
4. Understand the concept of multithreading on the single processor.
5. Start doing programming for the GUI applications.
6. Understand the connectivity process with the database server .

BCA308: Industrial Applications

Teaching Scheme	Examination Scheme
Lectures: 1 hr/Week	Class Test -6 Marks
Tutorials: 1 hr/Week	Teachers Assessment – 3 Marks
	Attendance – 6 Marks
Credits: 2	End Semester Exam – 35 Marks

Prerequisite: - English Grammar of 10+2 standard.

Course Objectives:
1. To understand the concepts, process and importance of communication.
2. To equip students with verbal and non-verbal communication skills.
3. To enhance their communication skills in real life situations.
4. To develop awareness regarding appropriate communication and presentation skills.
5. To encourage students by developing their critical thinking through activities.
6. To assist students with employability and job search skills.

Detailed Syllabus

Unit-1
Communication Skills: Verbal, Non-Verbal, Listening Skills, Writing Skills, Questioning Skills
Business Etiquette: Making the First Impression, Importance of Handshakes, Business Card Etiquette, Grooming and Personal Hygiene, Body Language, Telephone and email Etiquette

Unit-2
Presentation Skills: Fundamentals of an Effective Presentation, 5 P's of an Effective Presentation, Importance of Visual Aids, Understanding and Overcoming Fear of Public Speaking, Importance of Managing Voice and Language, Managing Question and Answer Session

Unit-3
Interpersonal and Team Skills: Initiating Small Talks, Managing Relationships, Understanding the Cultural Diversity, Teambuilding Process and Techniques, Coordination in Teams, Assertive Communication while Dealing with Teams, Balancing Team Needs and Individual Needs, Importance of Feedback in Team Building
Conflict Management: Conflict Resolution Strategies, Tools and Techniques for Conflict Management.

Unit-4
Facing Interview: Preparing to face interviews, Group Discussion, Resume Building, Role of Attitude: Positive mental attitude, Career Planning, Goal Setting: Establishing SMART Goals, Importance of Mission Statement, Formulation of Goals, understanding and overcoming Procrastination.

Text and Reference Books
1. Business Communication, Bovee & Thill, McGraw Hill, fifth edition, 2007.
2. Business Communication, Raymond V. Lesikar, McGraw Hill, 7th edition, 2009.
3. Soft Skills, Dr.K.Alex, S.Chand 8. Basic English Usage, Michael Swan, Oxford Indian Edition.
4. Business Communication, K.K. Sinha, Galgotia Publications.
5. Effective Speaking, Comfort, Jeremy, Cambridge University Press, 2002.
6. Essentials of Business Communication, Rajendra Pal, J.S. Korlahalli Sultans, Chand and Sons Company.

Course Outcomes:

After completing the course, students will be able to:

1.	Understand the process of communication and various Business Etiquettes.
2.	Exhibit better presentation skills and speak confidently.
3.	Apply effective communication skills in a variety of public and interpersonal settings.
4.	To draft effective correspondence with brevity and clarity.
5.	Demonstrate his verbal and nonverbal communication ability through presentations
6.	Know how to confidently face interview and group discussions.

Program Name- **INTRODUCTION TO DATA ANALYTICS**
Program Hours- **50**
Tentative Credit – **4**

OBJECTIVES
- This course will serve as a comprehensive introduction to various topics in Data Analytics.
- Conceptualization and summarization of data pre-processing and data wrangling.
- Representation of data and visualization of data with different techniques.
- Descriptive analytics for industrial data.
- Study the various Python libraries.

OUTCOMES
- At the end of the course the students should be able to design and implement machine learning solutions to classification, regression, and clustering problems, and be able to evaluate and interpret the results of the algorithms.
- Ability to identify the characteristics of datasets and compare the trivial data and big data for various applications.
- Ability to select and implement Data analytics techniques and computing environment that are suitable for the applications under consideration.
- Ability to solve problems associated with batch learning and online learning, and the big data characteristics such as high dimensionality, dynamically growing data and in particular scalability issues.

SCOPE
- Business Analyst
- Product Analyst
- Machine Learning Engineer
- Data Scientist

PROJECTS
- Smart Transportation
- Motor Anomaly Detection-Temp, Vibration, RPM, Load
- Quality of Road Analytics
- Battery Management system analytics (BMS)
- Lidar based Driving Skill Analytics

Module 1:

Project Presentation – Smart Electric Vehicle
Language - Keyword, Data Types, Data Type Operations, Statistics –Conditional Statements, Loops, exception handling, Function, Scope, File Handling, OOPS, Statistical Analysis, NumPy, Pandas, data set creation, libraries, and framework, Identifying invalid values.

Module 2:

Data Preprocessing: Data cleansing, series & data frame, functions on data frame, feature scaling, dimensionality reduction.

Module 3:

Custom Filtering and Selection: Sorting, group by split-apply-combine, handling missing data (missing imputation), indexing & selecting data, selection by level, selection by position, merging of data frame (concat and merge), reshaping: stack, unstack, pivot.

Module 4:

Exploratory Data Analysis: Finding the best attributes, principal component analysis, data normalization, time/date components, parsing & manipulating data, period & period index.

Module 5:

Data Visualization: Scatter Plots, Line Graphs, Bar Plots, Matplotlib, Seaborn, X And Y Ticks and Rotations, Histograms, Box Plot.

Module 6:

Data Scarping: Introduction to Web Scraping, Libraries - RE, REQUESTS, OS, BeautifulSoup, Data Collection & Filtering.

Reference Books & Materials:
- Introduction and History of Electric Vehicles
- Data Analytics : Data Analytics Tutorial for Beginners: A [Step-By-Step] Guide (simplilearn.com)
- Pandas – User Guide — pandas 1.4.4 documentation (pydata.org)
- NumPy – NumPy user guide — NumPy v1.23 Manual
- Matplotlib – Tutorials — Matplotlib 3.5.3 documentation
- Seaborn - User guide and tutorial — seaborn 0.11.2 documentation (pydata.org)

BCA401: Software Engineering

Teaching Scheme	Examination Scheme
Lectures: 5 hrs/Week	Class Test -20Marks
Tutorials: 1 hr/Week	Teachers Assessment - 10Marks
	Attendance – 20 Marks
Credits: 6	End Semester Exam – 100 marks

Prerequisite: - Computer Fundamental and Programming using C.

Course Objectives:

1. To recognize basic software design principles, software engineering methods and practices, software cost estimation, testing approaches and their appropriate application.
2. To exemplify the critical understanding of software process models, project management and requirements, implementation issues, verification and validation.
3. To implement techniques, skills, and modern software engineering tools for designing a system and to apply the basic project management practices in real life projects.
4. To demonstrate development of a computing-based system in terms of design, verification, validation, implementation, and maintenance within realistic constraints.
5. To evaluate software design principles, software requirements with existing tools and to test the project with respect to effort and development time.

Detailed Syllabus

Unit-1
Introduction: Introduction to Software Engineering, Software Characteristics, Software Engineering Processes, And Software Development Life Cycle (SDLC) Models: Water Fall Model, Prototype Model, Spiral Model, Evolutionary Development Models, and Iterative Enhancement Models.

Unit-2
Software Requirement Specifications (SRS): Requirement Engineering Process: Elicitation, Analysis, Documentation, Review and Management of User Needs, Feasibility Study, Data Flow Diagrams, Entity Relationship Diagrams, Decision Tables, SRS Document.

Unit-3
Software Design: Basic Concept of Software Design, Architectural Design, Low Level Design: Modularization, Design Structure Charts, Coupling and Cohesion, Top-Down and Bottom-Up Design Strategies: Function Oriented Design, Object Oriented Design.

Unit-4
Software Testing: Testing Objectives, Test Data Suit Preparation, Unit Testing, Integration Testing, Acceptance Testing, Regression Testing, Top-Down and Bottom-Up testing. White Box Testing, Black Box Testing, Alpha and Beta Testing of Products. Formal Technical Reviews, Walk Through, Code Inspection, Compliance with Design and Coding Standards.

Unit-5
Software Maintenance: Need for Maintenance, Preventive, Corrective and Perfective Maintenance Cost of Maintenance, Maintenance Models.

Unit-6
Software Project Management: Estimation of Various Parameters such as Size, Cost, Efforts, Schedule/Duration, Constructive Cost Model (COCOMO), Resource Allocation Models, Software Risk Analysis and Management, Software Quality Attributes and Factors Software Configuration Management, CASE Tools.

Text and Reference Books
1. Software Engineering: A Practitioners Approach, R. S. Pressman, McGraw Hill, 6th Edition.
2. Fundamentals of Software Engineering, Rajib Mall, PHI Publication, 2nd Edition.
3. K. K. Aggarwal and Yogesh Singh, Software Engineering, New Age International Publishers, 3rd Edition.
4. Software Engineering, Pankaj Jalote, Wiley, 5th Edition.
5. Ian Sommerville, Software Engineering, Addison Wesley, 7th Edition.

Course Outcomes:

After completing the course, students will be able to:

1.	Understand that how to apply the software engineering lifecycle by demonstrating competence in planning, analysis, design, testing and implementation.
2.	Identify the best software model to develop a real-life software product.
3.	Demonstrate an ability to use the techniques and tools necessary for engineering practice.
4.	Work in one or more significant application domains.
5.	Demonstrate an understanding of and apply current theories, models, and techniques that provide a basis for the software lifecycle.
6.	Work as an individual and as part of a multidisciplinary team to develop and deliver quality software.

BCA406: Web Based System Development

Teaching Scheme	Examination Scheme
Lectures: 3 hrs/Week	Class Test -12Marks
Tutorials: 1 hr/Week	Teachers Assessment - 6Marks Attendance – 12 Marks
Credits: 4	End Semester Exam – 70 marks

Prerequisite:-Java Programming, Database management system, Software Engineering

Course Objectives:

1. The main objective of this course to introduce the skills and project-based experience needed for entry into web application and development careers.

2. Objective of this course is to understand how to develop web pages and communicate with the server side.

3. To implement web-based information systems using various specialized web tools and technologies.

4. To understand concepts and specialist theories of web based system development.

5. To understand the development phases of web-based systems.

Detailed Syllabus

UNIT I
Introduction to Web Based System Development: History of web, Growth of the Web, Protocols, governing the web, Introduction to Cyber Laws in India, Introduction to International Cyber Laws, Web project, Web Team, Team dynamics.

UNIT II
Communication Issues: The Client, Multi-department & Large scales Websites, Quantity Assurance and testing, Technological advance and Impact on Web Teams.

UNIT III
HTML: HTML Formatting Tags, Links, List, Tables, Frames, Forms, Comments in HTML.

UNIT IV
Web Scripting: DHTML, JavaScript Introduction, documents, and documents, forms, Statements, Functions, Object in JavaScript, Events and Event Handling Arrays, FORMS, Buttons, Checkboxes, Text fields and Text areas.

UNIT V
XML: Introduction, displaying an XML document, Data Interchange with an XML document, document type definitions, Parsers using XML, Client side usage, Server Side usage.

UNIT VI
Introduction of Server Side Programming: JSP, Tomcat Server, ASP, ASP.NET, PHP

Text and Reference Books
1. Collaborative Web Development, Burdman, Addison Wesley, 1st Edition, 1999.
2. Developing E-Commerce Sites, Sharma, Sharma, Addison Wesley, 1st Edition.
3. Web Technologies Part II, Ivan Bayross, BPB Publications, 2008.
4. Essential COM, DON Box, Addison Wesley, 1997.
5. Bhave, "Programming with Java", Pearson Education
6. ASP Developer's Guide, Greg Buczek, TMH, October, 2002.
7. Ullman, "PHP for the Web: Visual QuickStart Guide", Pearson Education

Course Outcomes:

After completing the course, students will be able to:

1.	Learn different types of roles in web team and duties in web project in development.
2.	Learn programming builds and develop programs that use strings, dates, arrays, functions, classes and objects.
3.	Implement different parameters to create secure web sites.
4.	Design and develop web pages for any web application.
5.	Gather the skills to implement software for a client-server environment by using different programming and scripting languages.
6.	Learn markup language to build own tags to create web pages and server side scripting language to communicate between client and server.

BCA407: GUI using .Net Framework

Teaching Scheme	Examination Scheme	
Lectures: 3 hrs/Week	Class Test	– 12 Marks
Tutorials: 1 hr/Week	Teachers Assessment	– 6 Marks
	Attendance	– 12 Marks
Credits: 4	End Semester Exam	– 100 Marks

Prerequisite: OOPs Concepts, GUI Interfaces, HTML and CSS.

Course Objectives:
1. Learn about MS.NET framework developed by Microsoft.
2. You will be able to using XML in C#.NET specifically ADO.NET and SQL server.
3. Be able to understand use of C# basics, Objects and Types, Inheritance.
4. To develop, implement and creating Applications with C#.
5. To develop, implement, and demonstrate Component Services, Threading, Remoting, Windows services, web.
6. To understand and be able to explain Security in the .NET framework and Deployment in the .NET.
7. To develop Assemblies and Deployment in .NET, Mobile Application Development.

Detailed Syllabus:

Unit-1
The .Net framework: Introduction of .Net, The Origin of .Net Technology (OLE technologies, COM technologies, .NET technologies), The architecture of .Net Framework, Common Language Runtime (CLR), Common Type System (CTS), Common Language Specification (CLS), Microsoft Intermediate Language (MSIL), Just-In –Time Compilation, Framework Base Classes.
Unit-2
Introduction of Programming Language C#: Introduction of C#, Characteristics of C#, Differences between C# and C++, Differences between C# and JAVA, C# program introduction: The Main method specification, Namespace, Variables: Declaring implicit and explicit variables, Data-types, Boxing and Un-boxing.
Unit-3
Controlling program execution: IF statements, CASE (switch) statements, Operators, Looping, Storing multiple values with arrays. Inheritance, Method Overloading and method overriding, Polymorphism, Operator Overloading, Abstract Class, Inner Class, Interface, Delegates, Partial Classes, Errors and its types, Exception Handling.
Unit-4
GUI –Controls and There Event Handling: Text Box, Rich Text Box, Masked Text-box, Label, Link Label, Radio Button, Check Box, List Box, Combo Box, Checked List Box .Date Time Picker Control, Calendar Control, Tool Tip, Shock Web Flash Object.
Navigation Control and Its Event Handling: Context Menu Strip, Tool Strip, Status Strip, Tool Strip Container.
Unit-5
Containers and its Event Handling: Flow Layout Panel, Group Box, Panel, Split Container, Tab Control, Table Layout Panel.
Dialog Boxes and its Event Handling: Message Dialog Boxes, Color Dialog, Folder Browser Dialog, Font Dialog, Open File Dialog, Save File Dialog.

Unit-6
Data Controls: Data Source, Data Set, and Data Grid View displaying Record in the Grid View Controls. ADO.Net: Connected and Disconnected Architecture, Displaying Record from the Database, Inserting Record into Database, Creating Login using Database, Deleting Record from the Database, Fetching Record from the Database, Update Record in the Database, Creating Setup of .Net Application using Set up Wizard.

Suggested Readings:
1. Beginning Visual C# 2008, John Wiley, Wrox, May 2008.
2. Microsoft .Net for Programmers, Fergal Grimes, SPI, 2002.
3. Programming with C#, E. Balagurusamy, TMH, 1st Edition.

Course Outcomes:

After completing the course, students will be able to:

1.	Learn to develop Window Based Applications applications using C#.
2.	Learn to apply these languages to develop server-side applications which make use of ADO.NET, ASP.NET, Web Services etc.
3.	Understand use of C# basics, Objects and Types, Inheritance
4.	Develop, implement and creating Applications with C#.
5.	Develop, implement, and demonstrate Component Services, Threading, Remoting, Windows services, web
6.	Understand and be able to explain Security in the .NET framework and Deployment in the .NET.

BCA411: Cloud Computing

Teaching Scheme	Examination Scheme
Lectures: 5 hrs/Week	Class Test -20Marks
Tutorials: 1 hr/Week	Teachers Assessment - 10Marks Attendance – 20 Marks
Credits: 6	End Semester Exam – 100 marks

Prerequisite: - Introduction to Operating Systems, Computer Networking.

Course Objectives:

1. To describe grid and cloud computing as an emerging technologies.
2. To understand the importance of grid and cloud computing along with various security issues.
3. To identify the differences between various types of computing techniques, Cloud deployment models and service models.
4. To understand the implementation of cloud security and mobile cloud computing concepts..
5. To analyze various virtualization and scheduling techniques.
6. To study the design approaches used by various cloud service providers.

Detailed Syllabus

Unit-1
Introduction: Recent trends in computing, Introduction to Grid Computing: Motivation, Definition of Grid Computing, Evolution of Grid, Examples and Usages, Research Possibilities, Benefits of Grid Computing.

Unit-2
Grid Basics: Grid Architecture and its relationship to other distributed technologies, Grid Application Areas. **Security Issues in Grids:** Kerberos, GSI and Grid Security Framework. Migrating to Cloud.

Unit-3
Cloud Computing Basics- Cloud Computing Overview, Characteristics, Applications, Components, Benefits, Limitations, Challenges. First Movers in Cloud.
Cloud Computing Technology: Hardware and Infrastructure, Clients, Security, Network, Services.

Unit-4
Cloud Deployment Models: Private Cloud; Public Cloud; Community Cloud; Hybrid Cloud.
Cloud Computing Service Models: Infrastructure as a Service; Platform as a Service; Software as a Service. **Accessing the Cloud:** Web Applications, Web API's, and Web Browsers.

Unit-5
Cloud Storage and Security: Overview, Advantages, Storage as a Service, Security, Reliability, Advantages, Cautions, Theft, Cloud Storage Providers. **Standards:** Applications, Client, Infrastructure, Services.

UNIT-6
Virtualization Technologies: Types of Virtualizations, Benefits of Virtualization, Hypervisor.
Scheduling: Overview of Scheduling problem, Different types of scheduling, Scheduling Algorithms. Case Study of Amazon S3. Major Cloud Service providers.

Text and Reference Books

1- The Grid- Blueprint for a New Computing Infrastructure, Ian Foster, Carl Kesselman, 2nd Edition, Morgan Kaufmann Publications,2003.
2- Grid Computing: Making the Global Infrastructure a Reality, Francine Berman, Geoffrey Fox, Tony Hey, John Wiley & Sons, 2003.
3- Cloud Computing: Principles and Paradigms, Rajkumar Buyya and James Broberg, John Wiley & Sons, 2011.
4- Cloud Computing, A Practical Approach, Anthony T Velte, Mc Graw Hill, 2010.

Course Outcomes:

After completing the course, students will be able to:

1. Define Cloud Computing and memorize the different Cloud service and deployment models.
2. Describe importance of virtualization along with their technologies.
3. Use and Examine different cloud computing services.
4. Analyze the components of open stack & Google Cloud platform and understand Mobile Cloud Computing.
5. Describe the key components of Amazon web Service.
6. Design & develop backup strategies for cloud data based on features.

Program Name- **MACHINE LEARNING**
Program Hours- **50**
Tentative Credit – **4**

OBJECTIVES

- To provide big data computing environment: To analyze and Configure a Predictive Maintenance that can be implemented into a production environment to apply the predictive data model to streaming data.
- To provide Machine learning techniques: Three phases of machine learning. types of learning support vector machine. decision trees and random forests.
- To provide Scaling up machine learning: Dimensionality reduction techniques like principal component analysis and feature hashing.

OUTCOMES

- Ability to understand and apply scaling up machine learning techniques and associated computing techniques and technologies.
- Ability to recognize and implement various ways of selecting suitable model parameters for different machine learning techniques.
- Ability to integrate machine learning libraries and mathematical and statistical tools with modern technologies.

SCOPE

- Business Analyst
- Product Analyst
- Machine Learning Engineer
- Data Scientist

PROJECTS

- Heart Attack Prediction
- Rain prediction
- Sensex prediction
- Engine health prediction Vibration
- Movie Recommendation System
- Auto Correct Keyboard –NLP
- Match prediction Sports Data
- Gold price Prediction

MACHINE LEARNING

Module 1:

Introduction to Machine Learning: Introduction to Multi-Dimensional Data- tensor, Different Algorithms and applications, Regression, Classification, Clustering and Association Rule Learning.

Module 2:

Supervised learning: Regression, Simple & Multiple Linear Regression, Interaction Terms, Nonlinear Transformations, Dummy variable regression, K-fold Cross Validation, Subset selection methods.

Module 3:

Supervised learning: Support Vector Machines, Optimization Objective, The Maximal Margin Classifier, Kernel Method, and Nonlinear Decision Boundaries, one versus One Classification, one versus All Classification, Character recognition using SVM Using Support Vector for Regression.

Module 4:

Supervised learning: Random Forests & Decision Trees, Application of Random Forest, Ensembles of Estimators: Random Forests, Bagging and boosting, Feature training and testing, classification.

Module 5:

Supervised learning: Introduction to Logistic Regression, Logistic Model cost function, Estimating the Coefficients, Making Predictions, Odds-Ratio, Performance Evaluation Matrices, Sensitivity/Specificity/PPV/NPV, Precision, ROC curve etc., Regularized Logistic Regression.

Module 6:

Supervised learning: KNN (K-Nearest Neighbor), Background of KNN, Application of KNN, create a document retrieval system using k-nearest neighbors, identify various similarity metrics for text data, reduce computations in k-nearest neighbor search by using KD trees.

Reference Books & Materials:
- Machine learning basics –Machine Learning – GeeksforGeeks
- sklearn – 1. Supervised learning — scikit-learn 1.1.2 documentation
- Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems By Aurélien Géron
- Machine Learning Engineering Paperback — by Andriy Burkov

BCA501: Computer Graphics and Animation

Teaching Scheme	Examination Scheme	
Lectures: 3 hrs/Week	Class Test	– 12 Marks
Tutorials: 1 hr/Week	Teachers Assessment	– 6 Marks
	Attendance	– 12 Marks
Credits: 4	End Semester Exam	– 100 Marks

Prerequisite: Linear Algebra, Matrix, and C-Programming.

Course Objectives:

1. To introduce the use of the components of a graphics system and become familiar with building approach of graphics system components and algorithms related with them.
2. To learn the basic principles of 2- dimensional and 3- dimensional computer graphics.
3. Provide an understanding of how to scan convert the basic geometrical primitives, how to transform the shapes to fit them as per the picture definition.
4. Provide an understanding of mapping from a world coordinate to device coordinates, clipping, and projections.
5. To be able to discuss the application of computer graphics concepts in the development of computer games, information visualization, and business applications.

Detailed Syllabus:

Unit-1
Introduction to computer graphics: Types of computer graphics, Graphic Displays- Random scan displays, Raster scan displays, Color CRT, Flat panel displays, Frame buffer and video controller, interactive input and output devices.

Unit-2
Line drawing algorithms: DDA, Bresenham.
Circle generating algorithms: Midpoint circle generating algorithm, Bresenham circle generating algorithm.
Ellipse generating algorithms: Midpoint ellipse generating algorithm, Bresenham ellipse generating algorithm.

Unit-3
Polygon Filling: Scan line Polygon filling Algorithm, Boundary fill Algorithm, Flood fill Algorithm.
2D Transformations: Basic transformation, Matrix representations and homogenous coordinates, Composite transformations, Reflections and shearing.

Unit-4
Segment and Display files: Segments, Functions for segmenting the display file, Posting and un-posting a segment, segment naming schemes, Default error conditions, appending to segments, Refresh concurrent with reconstruction, Free storage allocation, display file structure. Interactive picture construction techniques.

Unit-5
Windowing and Clipping: Viewing pipeline, viewing transformations, 2-D Clipping algorithms-Line clipping algorithms such as Cohen Sutherland line clipping algorithm, Liang Barsky algorithm, Line clipping against non-rectangular clip windows.

Polygon clipping – Sutherland Hodgeman polygon clipping, Weiler and Atherton polygon clipping, Curve clipping, Text clipping.
Unit-6 **Three Dimensional:** 3-D geometric primitives, 3-D Transformation, 3-D viewing, projections, 3-D Clipping. **Curves and Surfaces:** Quadric surfaces, Spheres, Ellipsoid, Blobby objects, introductory concepts of Spline, Bezier curves and surfaces.

Suggested Readings:
1. Computer Graphics-C Version, Donald Hearn, M. Pauline Baker, Pearson Education, 2007
2. Computer graphics, Schaum's outline, TMH, 2006.
3. Computer Graphics: A Programming Approach, Steven Harrington, TMH, 1984.
4. Computer Graphics Principles and Practice, James D Foley, Pearson education 2004.

Course Outcomes:

After completing the course, students will be able to:

1. Have a knowledge and understanding of the structure of an interactive computer graphics system, and the separation of system components.
2. Have a knowledge and understanding of geometrical transformations and 3D viewing.
3. Have a knowledge and understanding of techniques for representing 3D geometrical objects.
4. Have a knowledge and understanding of interaction techniques.
5. Create interactive graphics applications.
6. Use C builds functions or equivalent graphics tools.
7. Perform simple 2D graphics with lines, curves and can implement algorithms to rasterizing simple shapes, fill and clip polygons and have a basic grasp of anti-aliasing techniques.

BCA512 (DSE1): Digital Image Processing with MatLab

Teaching Scheme	Examination Scheme
Lectures: 3 hrs/Week	Class Test -12Marks
Tutorials: 1 hr/Week	Teachers Assessment - 6Marks Attendance – 12 Marks
Credits: 4	End Semester Exam – 70 marks

Prerequisite: Basic Logical operations, Computer Graphics.

Course Objectives:

1. To describe and explain basic principles of digital image processing.
2. To study basic image operations.
3. To understand the algorithms that perform basic image processing (e.g. noise removal and image enhancement).
4. To design and implement algorithms for advanced image analysis (e.g. image morphing,image segmentation).
5. To expose students to current applications in the field of DIP.

Detailed Syllabus

UNIT I (6 Hours): Elements of Visual Perception, Image Sensing and Acquisition, Steps of DIP and its Applications, Components of Image Processing system, Image sampling andQuantization.
UNIT II (10 Hours): **Image Enhancement in Spatial Domain:** Basic Gray Level Transformation, Histogram Processing, Spatial Filtering, Smooth Spatial Filtering: SmoothingLinear Filters, Order-Statistics filters. Enhancement using arithmetic/Logic Operations
UNIT III (10 Hours): **Image Enhancement in Frequency Domain:** One dimensional Fourier frequency domain and its inverse, Basic properties of frequency domain, Smoothing Frequency- Domain Filters- Ideal Lowpass Filters, Butterworth Lowpass Filters, Gaussian Lowpass Filters, Sharpening Frequency Domain
UNIT IV (10 Hours): **Image Restoration:** Model of the Image Degradation/Restoration Process, Noise Models- Spatial and Frequency Properties of Noise, Important Noise Probability Density Functions, Periodic Noise,
UNIT V (10 Hours): **Morphological Image Processing:** Basic Concepts from Set Theory,Logic Operations Involving Binary Images, Dilation and Erosion, Opening and Closing, Hit or Miss Transformation,
UNIT VI (10 Hours): **Image Segmentation:** Detection of Discontinuities- Point Detection, Line Detection, Edge Detection, Edge Linking and Boundary Detection- Local Processing, Global Processing via the Hough Transform, Global Processing via Graph-Theoretic Techniques

Text and Reference Books
1. Fundamentals of Digital Image Processing, Anil K. Jain, Pearson, IIIrd, 2004.
2. Digital Image Processing, Rafel C. Gonzalez & Richard E. Woods, PHI, 10th, 2005.
3. Digital Image Processing using MATLAB, Rafel, Richard & Steven, Pearson, IInd, 2007.
4. Digital Image Processing, JayaramanS,VeerakumarT,Esakkirajan S, TMH, Ist, 2009.

Course Outcomes:

After completing the course, students will be able to:

1.	Understand general terminology of digital image processing.
2.	Examine various types of images, intensity transformations and spatial filtering.
3.	Develop Fourier transform for image processing in frequency domain.
4.	Evaluate the methodologies for image segmentation, restoration etc.
5.	Implement image process and analysis algorithms.
6.	Apply image processing algorithms in practical applications.

BCA513 (DSE1): Artificial Intelligence

Teaching Scheme	Examination Scheme
Lectures: 3 hrs/Week	Class Test -12Marks
Tutorials: 1 hr/Week	Teachers Assessment - 6Marks Attendance – 12 Marks
Credits: 4	End Semester Exam – 70 marks

Prerequisite: - Should have knowledge about advanced mathematics

Course Objectives:

1. The main objective of AI to build intelligent machine which can perform and act like humans.
2. The main objective of this course is to understand how these algorithms works and how to analyze the data to make a proper decision.
3. As we know AI is in used in all fields like healthcare industry, mobile world, Retail, Fraud detection etc. so demonstrate knowledge of the building blocks of AI as presented in terms of intelligent agents.
4. To initiate the concepts of a Rational Intelligent Agent and the different types of Agents that can be designed to solve problems in different fields.
5. To evaluate the different stages of development of the AI field from human like behavior to Intelligent Agents.

Detailed Syllabus

UNIT I **Introduction:** Overview of Artificial Intelligence- Problems Of AI, AI Technique. Problem Solving : Problems, Problem Space & Search: Defining The Problem As State Space Search, Production System, Problem Characteristics, Issues In The Design Of Search Programs.
UNIT II **Search Techniques:** Uniform Search Strategies: Breadth First Search, Depth First Search, Depth Limited Search, Bidirectional Search, Comparing Uniform Search Strategies, Greedy Best-First Search, A* Search, Genetic Algorithms.
UNIT III **Knowledge representation:** Knowledge Representation Issues, Representation and Mapping, Approaches To Knowledge Representation, Issues In Knowledge Representation, Knowledge manipulation, Knowledge acquisition.
UNIT IV **Using Predicate Logic:** Representing Simple Fact in Logic, Representing Instant & ISA Relationship, Computable Functions & Predicates, Resolution, Natural Deduction. Representing Knowledge Using Rules : Procedural Verses Declarative Knowledge, Logic Programming,Forward Verses Backward Reasoning, Matching, Control Knowledge.
UNIT V **Probabilistic Reasoning:** Representing Knowledge in an Uncertain Domain, The Semantics of Bayesian Networks, Dempster-Shafer Theory. Introduction of Natural Language Processing
UNIT VI Expert System-Rule based system architecture, Non production system architecture, knowledge organization and validation, Existing Systems (DENDRAL, MYCIN).

Text and Reference Books
1. "Artificial Intelligence", Ritch& Knight, TMH, 2006.
2. "Introduction to Artificial Intelligence & Expert Systems", Patterson, PHI, 2007.
3. "Artificial Intelligence: A Modern Approach", Russell, S., Norvig, P, Pearson Education, 2006.
4. "Introduction to A.I.", Charnick, Addision Wesley, 1999.

Course Outcomes:

After completing the course, students will be able to:

1. How to solve a particular problem by using different algorithms which is impossible for humans.
2. How to make proper decisions by gathering information and analyzing them.
3. How expert system works and perform tasks.
4. How to convert a particular sentence into logical statement.
5. Analyze the problem as a state space, graph, design heuristics and select amongst differentsearch based techniques to solve them.
6. Apply concept Natural Language processing to problems leading to understanding ofcognitive computing.

BCA514 (DSE1): UNIX and Shell Programming

Teaching Scheme	Examination Scheme
Lectures: 3 hrs/Week	Class Test -12Marks
Tutorials: 1 hr/Week	Teachers Assessment - 6Marks Attendance – 12 Marks
Credits: 4	End Semester Exam – 70 marks

Prerequisite: - DOS Operating System

Course Objectives:

1. To familiarize the students with the Operating System.
2. To demonstrate the process, memory, file and directory management issues under the UNIX
3. Operating system.
4. To introduce UNIX basic commands.
5. To make students how to make simple programs in UNIX and administrative task of UNIX.

Detailed Syllabus

UNIT I (6 Hours)
Introduction to UNIX: features of UNIX, Shell Vs Kernel, types of shell, System Calls, System calls Vs Library functions, UNIX file System, The Parent-Child Relationship, Orphan, Zombie, UNIX Architecture, UNIX Commands.

UNIT II (10 Hours)
The first faltering step(Login), Password, Password Ageing, files related commands, Symbolic links, Listing Files & directories, Hidden files, Shell Meta characters, Masking file permission, Changing file permission(Absolute & Symbolic mode), Sticky bit, Directory related commands, Best calculator.

UNIT III (10 Hours)
The UNIX file system, INODE Table, Disk related commands, File related commands, viewing files, Locating files, Taking printouts, File Compression (File Compression & Archiving), Filters, The Stream Editors, I/O redirection & Piping, Command substitution.

UNIT IV (10 Hours)
Process basic, process status, Mechanism of process creation, Job Control, background processes, killing a process, Daemon, changing process priorities, Scheduling a process, process synchronization, Semaphores, Communication in UNIX,
System Administration in UNIX- the System administrator's login, the administrator's privileges, Adding & Removing groups, user's management, Booting & Shutdown, Making a file system, Mounting & Unmounting File system.

UNIT V (10 Hours)
Editor, types of editor (vi and ed), Modes of operation in vi, Navigation in vi (use of h, j, k and lkeys), word navigation (use of b, e and w keys), Scrolling, deleting text, copy & paste in vi, block commands, Searching, Find & replace, Abbreviation(abbr), set command.

UNIT VI (10 Hours)

Shell Scripts/program, need of shell scripts, Interactive shell scripts, shell variables, shell keywords, System variables, shell keywords, System variables, user defined variables, Command line arguments, exit and status of command, use of operators, Control Instructions in shell.

Text and Reference Books

1. UNIX shell programming by Yashvant Kanetkar ---BPB Publications
2. UNIX Concepts and Application by Sumitabha Das--- Tata McGraw-Hill publication
3. The C Odyssey UNIX the open boundless C By Meeta Gandhi--- BPB Publications

Course Outcomes:

After completing the course, students will be able to:

| 1. Knowledge about working environment in UNIX. |
| 2. Knowledge about the UNIX commands to perform different tasks. |
| 3. Difference between DOS and UNIX environment. |
| 4. Create or design different scripts using shell programming. |
| 5. Implement process, thread, semaphore concept of operating system |
| 6. Responsibilities and duties of a system administrator along with the knowledge how to grant permission to users, create user account etc. |

BCA515 (DSE1): PHP

Teaching Scheme	Examination Scheme
Lectures: 3 hrs/Week	Class Test -12Marks
Tutorials: 1 hr/Week	Teachers Assessment - 6Marks Attendance – 12 Marks
Credits: 4	End Semester Exam – 70 marks

Course Objectives:

1. To give knowledge about server site programming.
2. To introduce latest web development language.
3. To give knowledge about MySQL database management.
4. To explore the skills of programming in the file of online web project.

Detailed Syllabus

Unit-1
Introduction to PHP:- Evaluation of PHP, Basic Syntax, Defining variable and constant, PHP Datatype , Operator and Expression, Making Decisions, Doing Repetitive task with looping, Mixing Decisions and looping with Html.

Unit-2
Function: - What is a function, define a function, call by value and Call by reference, Recursive function, PHP GET and POST, Built-in Functions, User-Defined Functions, Functions with Parameters, Values and arguments in Function..

Unit-3
String and Array:- String - Creating and accessing String, Searching & Replacing String, Formatting String, String Related Library function , Array- Anatomy of an Array, Creating index based and Associative array, Accessing array Element, Looping with Index based array, Looping with associative array using each() and foreach(), Some useful Library function

Unit-4
Introduction to OOPS- Introduction, Objects, Declaring a class, The new keyword and constructor, Destructor, Access method and properties using $this variable, Public, private, protected properties and methods, Static properties and method, Class constant, Inheritance & code reusability, Polymorphism, Parent:: & self:: keyword, Instance of operator, Abstract method and class, Interface, Final

Unit-5
Exception Handling, file and Directories:- Understanding Exception and error, Try, catch, throw, Global Exception Handler, Defining Custom Exceptions, Understanding file& directory, Opening and closing a file, Coping, renaming and deleting a file, working with directories.

Unit-6
Database Connectivity with MySql:- Introduction to RDBMS, Connection with MySql Database, Performing basic database operation (DML) (Insert, Delete, Update, Select), Executing query, Framework.

Text and Reference Books
1. Lynn Beighley & Michael Morrison- Head First PHP & MySQL.
2. Robin Nixon: Learning PHP, MySQL, Java script and CSS: A step-by-step guide to creating dynamic websites.
3. Luke Welling & Laura Thompson: PHP & MYSQL web development

Course Outcomes:

After completing the course, students will be able to:

1.	Understand various types of website development using PHP and MySQL.
2.	Analyze the latest language designing and optimize new technology.
3.	Identify difference between traditional web development and PHP web development.
4.	Understand level of web technology at corporate level.
5.	Learning professional framework of PHP and MySQL for project development.

BCA516 (DSE1): Advanced Java

Teaching Scheme	Examination Scheme
Lectures: 3 hrs/Week	Class Test -12Marks
Tutorials: 1 hr/Week	Teachers Assessment - 6Marks Attendance – 12 Marks
Credits: 4	End Semester Exam – 70 marks

Prerequisite: C Programming, and OOPs Concepts.

Course Objectives:

1. To understand the basic concepts of Java, Importance of Classes & objects along with Method overloading and overriding.
2. To understand the conditional construction, arrays as well as Packages.
3. To learn the Exception Handling and I/o file handling with buffer reader and scanner class.
4. To understand importance of Multi-threading and AWT that respond to different user events.
5. To learn experience of Java swing and JDBC.
6. To understand Java beans and Java servlets for web development.

Detailed Syllabus:

Unit-1 **Introduction of Java**: Features of Java Language, Platform Independency, JVM, Byte-code,Operator, Data type, Variables, Robustness. **OOPS:** Method Overloading, Method Overriding, Abstraction, Interface, Polymorphism,Inner Class & Anonymous Classes, Abstract Class.
Unit-2 **Packages and Exception Handling:** Data Encapsulation, Concept of Package, creatingpackage, Importing packages, Child Packages.
Unit-3 **Exception Handling:** Exceptions & Errors, Types of Exception, Control Flow in Exceptions, Use of try, catch, finally, throw, throws in Exception Handling. Checked and Un-Checked Exceptions. **I/O and File Handling:** Buffered Reader class, InputStreamReader class, Scanner class,Creating File, Reading File and Writing File
Unit-4 **Multi-Threading:** Understanding Threads, Needs of Multi-Threaded Programming, Solution of Producer consumer problem by Multi Thread, Thread Life-Cycle, Thread Priorities, Synchronization of Thread. **AWT:** Introduction to AWT, AWT controls, Layout managers, Menus, Images.
Unit-5 **Java Swing:** Creating a Swing Applet and Application, Programming using Panes, Labels, Text fields, Buttons, Toggle buttons, Checkboxes, Radio Buttons, Scroll Panes, Scroll Bars, Lists, Combo box, Progress Bar, Menus and Toolbars, Layered Panes, Tabbed Panes, Split Panes, Layouts, Windows, Dialog Boxes. **JDBC:** The connectivity Model, JDBC/ODBC Bridge, java.sql package, connectivity to remote database, navigating through multiple rows retrieved from a database.

Unit-6
Java Beans: Application Builder tools, the bean developer kit (BDK), Developing a simple bean, TheJava Beans API.
Java Servlets: Servlet basics, Servlet API basic, Life cycle of a Servlet, Running Servlet, Debugging Servlets, Thread-safe Servlets, HTTP Redirects, Cookies, Introduction to Java Server pages (JSP).

Suggested Readings:
1.   The Complete Reference: Java, Herbert Schieldt, TMH, 7th Edition 2006
2.   Programming in JAVA, E. Balagurusamy, TMH, 2nd Edition 2007
3.   Object Oriented Modeling and Design, James Rumbaugh et al, PHI, 4th Edition 2003
4.   Object Oriented Analysis & Design with Application, Booch Grady, PearsonEducation, New Delhi, 3rd Edition, 2006.

Course Outcomes:

After completing the course, students will be able to:

1. Implement Object Oriented programming concept using basic syntaxes of controlsStructures, strings and function for developing skills of logic building activity.
2. Demonstrates how to achieve reusability using inheritance, interfaces and packages anddescribes faster application development can be achieved.
3. Demonstrate understanding and use of different exception handling mechanisms andconcept of multithreading for robust faster and efficient application development.
4. Demonstrate understanding and use of multi-threading and AWT.
5. Identify, Design & develop complex Graphical user interfaces using Java Swing classes.
6. Demonstrates how to implement Java Beans and Java Servlets.

BCA508 (GE3): Cyber Ethics

Teaching Scheme	Examination Scheme
Lectures: 1 hrs/Week	Class Test -6 Marks
Tutorials: 1 hr/Week	Teachers Assessment – 3 Marks Attendance – 6 Marks
Credits: 2	End Semester Exam – 35 marks

Prerequisite: Data & Network Security

Course Objectives:

1. The students will understand the importance of professional practice, Law and Ethics in their personal lives and professional careers.
2. The students will learn the rights and responsibilities as an employee, team member and a global citizen

Detailed Syllabus:

Unit-1

Cyber Crime: Definition and Origin of the Word, Cyber Crime and Information Security, Who are Cyber Criminals, Classification of Cybercrimes, E-mail Spoofing, Cyber Defamation, Internet Time Theft, Salami Attack, Salami technique Data Diddling, Forgery, Web Jacking,Newsgroup Spam, Industrial Spying,, Hacking, Online Frauds, Pornographic Offenders, Software Piracy, Computer Sabotage Email Bombing, Computer Network Intrusion, Password Sniffing, Credit Card Frauds, Identity Theft.

Unit-2

Cyber Offenses: How Criminals plan them, Categories of Cyber Crimes, How Criminal Plans the Attack : Active Attacks, Passive Attacks, , Social Engineering, Classification of Social Engineering, Cyber Stalking : types of Stalkers, Cyber Cafe and Cyber Crimes, Botnets , Attack Vectors, Cyber Crime and Cloud Computing.

Unit-3

Cyber Crime : The Legal Perspectives, The Cyber Crime Indian Perspectives, The Cyber Crime And Indian ITA 2000/2001, Hacking and Indian Laws, Global Perspective on Cyber Crime , Cyber Crime and extended Enterprise.

Unit-4

Tools and Methods used in Cybercrime: Proxy server and Anonymizers, phishing: How Phishing works? How password cracking works? Keylogers and Spywares, Virus and Worms, Trozan Horses and Backoors, Dos and Ddos Attacks, SQL Injection, Buffer Overflow, An Attacks on Wireless Networks

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Unit-5

Phishing and Identity Theft: Phishing: Methods of Phishing, Phishing Techniques, Types of Phishing Scams, Phishing countermeasures, Identity theft, Types and Techniques of identity thefts and its counter measures.

Unit-6

Understanding Computer Forensics: Digital forensic Science, Need for Computer Foransic, Cyber Forensic and digital Evidence and rules of Evidence, Forensics Analysis of E-Mail, Digital Forensic Life Cycle.

References:

1. Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives By Nina Godbole, SunitBelapur, Wiley.
2. Debby Russell and Sr. G. T Gangemi, "Computer Security Basics (Paperback), 2nd Edition, O Reilly Media.
3. Thomas R. Peltier, Information Security policies and procedures: A Practitioners Reference, 2nd Edition Prentice Hall

Course Outcomes:

After completing the course, students will be able to:

> **1.** To identify and describe the major types of cybercrime.
>
> **2.** To identify cybercrime vulnerabilities and exploitations of the Internet.
> **3.** Identify various classifications of cybercrimes and cyber-criminals.
> **4.** To identify appropriate responses to cyber-criminal activity.
> **5.** To understand the law with regards to the investigation and prosecution of cyber criminals.
> **6.** To identify appropriate law enforcement strategies to both prevent and control cybercrime.
> **7.** Explain jurisdictional challenges that nations face when responding to cybercrime

BCA509 (GE3): Digital Marketing

Teaching Scheme	Examination Scheme
Lectures: 1 hrs/Week	Class Test -6 Marks
Tutorials: 1 hr/Week	Teachers Assessment – 3 Marks
	Attendance – 6 Marks
Credits: 2	End Semester Exam – 35 Marks

Prerequisite: Knowledge of Social Media Platforms.

Course Objectives:
1. To understand the importance of Digital Marketing.
2. To study various types of Digital Marketing.
3. To know the significance of Digital and Internet Marketing.
4. To understand the recent trends in digital advertising and SEO.
5. To create a campaign on any social media platform.

Detailed Syllabus:

Unit-1
Introduction to Digital Marketing: Evolution of Digital Marketing from traditional to modern era, Role of Internet; Current trends, Info-graphics, implications for business & society; Emergence of digital marketing as a tool; Drivers of the new marketing environment; Digital marketing strategy; P.O.E.M. framework, Digital marketing plan, Digital marketing models.

Unit-2
Internet Marketing and Digital Marketing Mix: Internet Marketing, opportunities and challenges; Digital marketing framework; Digital Marketing mix. Introduction to Content Marketing, Email Marketing, Web analytics, Conversion Rate Optimization, Sales Funnels and Affiliate Marketing.

Unit-3
Social Media Marketing: Role of Influencer Marketing, Tools & Plan–Introduction to social media platforms, penetration characteristics; Building a successful social media marketing strategy. Facebook Marketing, LinkedIn Marketing, Twitter Marketing, Instagram Marketing: Introduction and framing content strategy, Advertising.

Unit-4
Mobile Marketing: Mobile Advertising, Forms of Mobile Marketing, Features, Mobile Campaign Development, Mobile Advertising Analytics.

Unit-5
Introduction to SEO and SEM: Trends in Digital Advertising– - Introduction and need for SEO, how to use internet & search engines; search engine and its working pattern, On-page and off-page optimization, SEO Tactics, Introduction to SEM.

Unit-6
Web Analytics: Google Analytics & Google Ad Words; data collection for web analytics. Online Reputation Management.

Suggested Readings:
1.Seema Gupta, Digital Marketing, Mc-Graw Hill, 1st Edition - 2017
2. Ian Dodson, The Art of Digital Marketing, Wiley Latest Edition
3.Puneet Singh Bhatia, Fundamentals of Digital Marketing, Pearson 1st Edition – 2017
4.Vandana Ahuja, Digital Marketing, Oxford University Press Latest Edition
5. Philip Kotler Marketing 4.0: – Moving from Traditional to Digital Wiley 2017

Course Outcomes:

After completing the course, students will be able to:

1. Understand the concept of Digital Marketing
2. Develop insight on Current Trends – Digital and Social Statistics (Infographics)
3. Provide an introduction to Digital Marketing Platforms like Facebook, Twitter, YouTube, etc.
4. Understand the basics of Search Engine Optimization (SEO) and Mobile Marketing.
5. Know various strategies involved in Marketing products and Services Digitally.

Program Name- **DEEP LEARNING**
Program Hours- **50**
Tentative Credit – **4**

OBJECTIVES
- To create appreciation and understanding of both the achievements of AI and the theory underlying those achievements.
- To introduce the concepts of Computer Vision & Natural Language Processing that can be designed to solve problems.
- To impart basic proficiency in representing difficult real-life problems in a state space representation to solve them using AI techniques.
- To create an understanding of the basic issues of knowledge representation, as well as an understanding of topics such as parallel processing, accelerated computing & GPU etc. that play an important role in AI programs.

OUTCOMES
- Demonstrate knowledge of the building blocks of AI as presented in terms of intelligent agents.
- Analyze and formalize the problem as a state space, graph, design heuristics and select amongst different searches.
- Develop intelligent algorithms for constraint satisfaction problems and design intelligent systems for Industrial Manufacturing Processes.
- Attain the capability to represent various real life problem domains using logic-based techniques and use this to perform inference or planning.

SCOPE
- AI Developer and AI Analyst
- Data Scientist

PROJECTS
- Parallel Processing
- AI Networks Design
- Smart Systems

DEEP LEARNING

Module 1:

Introduction to AI, CV, NLP: Applications of CV, Applications of NLP, Need for CV, and NLP Engineers Introduction to course. Learning mechanisms – 1: Introduction to types of learning mechanisms, Supervised – regression, classification, SVMs. Introduction to parallel processing: Parallel processing, Accelerated computing & GPUs.

Module 2:

Neural networks: Biological neurons and Perceptrons, Multi-layer Perceptrons, Activation functions, Feed forward networks & Backpropagation, Base optimizers and loss functions, Training multi-layer perceptron.

Module 3:

Introduction to image processing: Image processing libraries, Simple image processing functionalities, Feature extraction. **Building blocks of deep learning Layers:** Activation functions, Network creation and visualization.

Module 4:

Computer Vision Level 1 work – CV Data collection, Data annotation, Classification data – EDA, Data augmentation, Data preprocessing.
Computer Vision Level 2 work: Optimizers and Loss functions, Training and Hyper-parameters, Evaluation and Inferencing, Process Monitoring.
Computer Vision Level 3 work: Blocks and CNNs, Transfer learning, Multi label image classification.

Module 5:

Approach using different libraries: TensorFlow (+keras), Mxnet, Chainer, Paddle. Computer Vision Level 4 work: Post training optimization, Computer Vision Level 5 work: Peripheral tech integration, Processes, microservices and APIs, Model deployment and hosting.
Learning mechanisms – 3: Semi-supervised learning, Unsupervised learning.

Reference Books & Materials:
- Learn AI with Python
- Starting with Pytorch
- OpenCV – Tutorial
- AI Tutorials
- Natural Language Processing with Python by Steven Bird, Ewan Klein, Edward Loper

BCA604: Advanced SQL Programming

Teaching Scheme	Examination Scheme
Lectures: 3 hrs/Week	Class Test -12Marks
Tutorials: 1 hr/Week	Teachers Assessment - 6Marks
	Attendance – 12 Marks
Credits: 4	End Semester Exam – 70 marks

Pre-requisites: Basic computer literacy including ability to create and manipulate files and install software.

Course Objectives:
1. Knowledge of DBMS, both in terms of use and implementation/design.
2. Understand basic database concepts, including the structure and operation of the relational data model. Discussed about the normalizations.
3. Learn structured query language (SQL) to an intermediate/advanced level.
4. Understand the structure and design of relational databases and using different quarries
5. Be able to write PL/SQL statements that create database objects.
6. Understand the importance commands are procedure, function, trigger.

Detailed Syllabus

Unit-1
Database Concept: Database and Data Base Management System Definition, File Management System and its disadvantages, Benefits of DBMS, RDBMS Definition, DBMS V/S RDBMS.

Unit-2
Relational Databases: E.F Codd's Rules, Normalization: 1NF, 2NF, 3NF, BCNF. Relational Databases Terminology: Relation, Tuple, Attribute, Cardinality, Degree, Domain.

Unit-3
Keys:Super Key, Candidate Key, Primary Key, Foreign Key. Structured Query Language: Features of SQL, SQL *PLUS, SQL V/s SQL *PLUS, Rules for SQL, SQL Delimiters, Components of SQL. Constraints: Data constraints, Types of data constraints: UNIQUE, NOT NULL at column level, CHECK, NULL value constraint

Unit-4
Relational Databases: Relational Algebra. Operations, Select, Project, Union, Difference, Intersection Cartesian product, Join, Natural Join, Simple Queries, Nested Queries, Join queries, semi-join queries, self-join.

Unit-5
PL/SQL: Basic Introduction, Advantages of PL/SQL, The generic PL/SQL block, Literals, Variables, Constants, Comparisons, Comments. **Control Structure:** Conditional Control, Iterative Control and Sequential Control.

Unit-6
PL/SQL Transaction: Cursor, Types of Cursor: Implicit cursor, Explicit cursor.
PL/SQL Database objects: Introduction of Procedure and Functions, Advantages of using Procedure and Functions, Database Triggers, Triggers v/s Procedure, Types of Triggers

Text and Reference Books
1. Database System Concepts, Henry Korth, A. Silberschatz, 5th Edition, 2005.
2. SQL, PL/SQL the Programming Language of Oracle, Ivan Bayross, BPB Publications, 4th Edition.
3. Schaum's Outline of "Fundamental of Relational Databases", Ramon A. Mata, Pauline K. Cushman, McGraw Hill, December, 2006.

Course Outcomes:

After completing the course, students will be able to:

1.	Students will familiar database and file management.
2.	Students will follow the E.F Codd's Rules and understand the normalization and importance in RDBMS.
3.	To understand the indignity constraints and various keys, features of SQL, SQL *PLUS.
4.	Students will study of Relational databases and Relational algebra.
5.	Students will understand the Literals, Variables, Constants, Comparisons, Comments.
6.	To understand the PL/SQL Transaction used by Cursor, Implicit cursor, Explicit cursor and type of trigger.

BCA611 (GE4): Mobile Computing

Teaching Scheme	Examination Scheme
Lectures: 1 hrs/Week	Class Test -12Marks
Tutorials: 1 hr/Week	Teachers Assessment - 6Marks Attendance – 12 Marks
Credits: 2	End Semester Exam – 35 marks

Pre-requisites: Mobile communication and Computer Network, INTERNET, Router

Course Objectives:

1. To introduce the characteristics, basic concepts and systems issues in mobile and pervasive computing.
2. Describe and designing of GSM architecture and HLR/VRL. So that it can be able to solvethe mobile connective problems
3. To design successful mobile and pervasive computing applications and services.
4. To analyze the strengths and limitations of the tools and devices for development of pervasive computing systems
5. To introduce wireless communication and networking principles, that support connectivity to cellular networks, wireless internet and sensor devices.
6. Creatively analyze mobile and wireless network

Detailed Syllabus

Unit-1
Introduction to mobile communication and computing, Generations of mobile computing, Issues and Applications of mobile computing, Cellular concept and cellular architecture, Frequency reuse, handoff in mobile computing.

Unit-2
GSM: GSM architecture, HLR, VLR, protocol, Call flow sequence in GSM, Security in GSM.CDMA, IS-95 the North American CDMA, Service aspects, radio aspects.

Unit-3
Wireless LAN, Architecture, IEEE-802.11, Hidden and Exposed Terminal Problems. Bluetooth, Bluetooth Architecture, Mobile IP, Terminologies.

Unit-4
Location Management- Motivation, Network Architecture, Location Management in Cellular Network, Static and Dynamic Location Management, Location Management in Wireless Data Networks.

Unit-5
Data Management- Data Management Issues, Mobile Databases, Impact of Mobile Computingin the Area of Data Management, Data Replication, Asynchronous and Synchronous Replication.

Unit-6
File System: CODA File System. Adaptive Clustering: Adaptive Clustering for Mobile Wireless Networks, Architecture, Algorithm, Cluster Maintenance.

Text and Reference Books
1. Ashok K Talukdar: Mobile Computing-Technology, Applications and Service Creation, 1st Edition,TMH Publication, 2006.
2. J Schillar: Mobile Communications, 2nd Edition, Pearson Education, 2009.
3. Vishnu Sharma- Mobile computing , 4th Edition, Pearson Eduction, 2010.

Course Outcomes:

After completing the course, students will be able to:

1. Apply the fundamental design paradigms and technologies to mobile computing applications.
2. Demonstrate the different wireless technologies such as CDMA, GSM, and GPRS etc.
3. To design and considerations for deploying the wireless network infrastructure
4. To easily understand and design network architecture
5. Evaluate network protocols, routing algorithms, connectivity methods and characteristics
6. To understand and evaluate CODA File System and Adaptive Clustering for mobile computing

BCA612 (GE4): Software Project Management

Teaching Scheme	Examination Scheme
Lectures: 1 hrs/Week	Class Test -12Marks
Tutorials: 1 hr/Week	Teachers Assessment - 6Marks Attendance – 12 Marks
Credits: 2	End Semester Exam – 35 marks

Prerequisite: - Software Engineering

Course Objectives:

1. Apply project management concepts and techniques to an IT project.
2. Identify issues that could lead to IT project success or failure.
3. Explain project management in terms of the software development process.
4. Describe the responsibilities of IT project managers.

Detailed Syllabus

Unit-1
Project Evaluation and Project Planning: Importance of Software Project Management, Activities, Methodologies, Categorization of Software Projects. Setting objectives, Management Principles, Management Control, Project portfolio Management, Cost-benefit evaluationtechnology. Risk evaluation, Strategic program Management Stepwise Project Planning.

Unit-2
Project Life Cycle and Effort Estimation: Software process and Process Models, Choice of Process models, Rapid Application development, Agile methods, Dynamic System DevelopmentMethod, Extreme Programming, Managing interactive processes, Basics of Software estimation,Effort and Cost estimation techniques, COSMIC Full function points, COCOMO II – a Parametric Productivity Model.

Unit-3
Activity Planning: Objectives of Activity planning, Project schedules, Activities, Sequencing and scheduling, Network Planning models, Formulating Network Model, Forward Pass & Backward Pass techniques, Critical path (CRM) method.

Unit-4
Risk Management: Risk identification, Assessment, Risk Planning, Risk Management, PERT technique. Monte Carlo simulation, Resource Allocation, Creation of critical paths, Cost schedules.

Unit-5
Project Management and Control: Framework for Management and control, Collection of data, Visualizing progress, Cost monitoring, Earned Value Analysis, Prioritizing Monitoring, Project tracking, Change control, Software Configuration Management, Managing contracts, Contract Management.

Unit-6
Staffing In Software Projects: Managing people, Organizational behavior, Best methods of staff selection, Motivation , The Oldham Hackman job characteristic model, Stress, Health and Safety, Ethical and Professional concerns, Working in teams, Decision making, Organizational structures, Dispersed and Virtual teams, Communications genres, Communication plans, Leadership.

Text and Reference Books:
1- Bob Hughes, Mike Cotterell and Rajib Mall: Software Project Management – Fifth Edition, TataMcGraw Hill, New Delhi, 2012.
2- Robert K. Wysocki, Effective Software Project Management – Wiley Publication, 2011.
3- 3- Walker Royce, Software Project Management- Addison-Wesley, 1998.
4- Gopalaswamy Ramesh, Managing Global Software Projects – McGraw Hill Education (India), Fourteenth Reprint 2013.

Course Outcomes:

After completing the course, students will be able to:

1. Identify the different project contexts and suggest an appropriate management strategy.
2. Practice the role of professional ethics in successful software development.
3. Identify and describe the key phases of project management.
4. Perform case studies on cost estimation models like COCOMO and COCOMO II .
5. Determine an appropriate project management approach through an evaluation of the business context and scope of the project.
6. Implement a WBS for a given specific software application.
7.Comparative analysis on Process Vs Product metrics.

BCA613 (DSE2): Artificial Neural Networks

Teaching Scheme	Examination Scheme
Lectures: 5 hrs/Week	Class Test -12Marks
Tutorials: 1 hr/Week	Teachers Assessment - 6Marks Attendance – 12 Marks
Credits: 6	End Semester Exam – 100 marks

Prerequisite: - Machine Learning

Course Objectives:

1. Develop the skills to gain a basic understanding of neural network theory and fuzzy logic theory.
2. Introduce students to artificial neural networks and fuzzy theory from an engineering perspective.
3. To give design methodologies for artificial neural networks.
4. To provide knowledge for network tunning and overfitting avoidance.
5. To offer neural network implementations.
6. To demonstrate neural network applications on real-world tasks.

Detailed Syllabus:

Unit-1
Fundamental of Neural Networks: Introduction, Model of Artificial Neuron, Architectures, Learning Methods, Taxonomy of NN Systems, Single Layer NN System, Applications.

Unit-2
Multilayer NN System and Backpropagation Networks: Background, Backpropagation Learning, Backpropagation Algorithm, Learning in Multilayer NN Systems. Applications of Backpropagation Algorithm.

Unit-3
Associative Memory: Introduction, Auto-associative Memory, Bi-directional Hetro-associative memory. Applications of Associative Memory.

Unit-4
Self- Organizing Maps (SOMs): Introduction to supervised and unsupervised learning. Competitive Learning, SOMs and their working principles, applications.

Unit-5
Adaptive Resonance Theory: Stability-Plasticity Dilemma, ART Networks, Iterative Clustering, Unsupervised Learning, ART Networks and their working principles, applications.

Unit-6
Introduction to Soft Computing: Basics of Soft Computing, Components of Soft Computing. Introduction to Fuzzy Logic, Genetic Algorithms.

Text and Reference Books
1. Neural Networks, Fuzzy Logic and Genetics Algorithms- Synthesis and Applications.
2. Rajasekaran and G.A. Vijaylakshmi Pai, Prentice Hall.
3. Neural Networks: A Comprehensive Foundation by Simon S. Hakin, Prentice Hall.
4. Fundamental of Neural networks: Architecture, Algorithms and Applications by Laurene V. Fausett,Prentice Hall.

Course Outcomes:

After completing the course, students will be able to:

1. Comprehend the fuzzy logic and the concept of fuzziness involved in various systems and fuzzy set theory.
2. Understand the concepts of fuzzy sets, knowledge representation using fuzzy rules, approximate reasoning, fuzzy inference systems, and fuzzy logic
3. To understand the fundamental theory and concepts of neural networks, Identify different neural network architectures, algorithms, applications and their limitations
4. Understand appropriate learning rules for each of the architectures and learn several neural network paradigms and its applications
5. Reveal different applications of these models to solve engineering and other problems.

BCA614 (DSE2): E-Business with Security Issue

Teaching Scheme	Examination Scheme
Lectures: 5 hrs/Week	Class Test -12Marks
Tutorials: 1 hr/Week	Teachers Assessment - 6Marks Attendance – 12 Marks
Credits: 6	End Semester Exam – 100 marks

Prerequisite: - Computer Networking, Principles of Management

Course Objectives:

1. Define e-commerce and e-Business.
2. Compare e-commerce with traditional commerce.
3. Understand media convergence.
4. Explain the business applications of e-commerce.
5. Discuss the need for e-commerce and e-Business.
6. Describe the basics of e-commerce: network and electronic transaction today.

Detailed Syllabus

Unit-1
Introduction to Electronic Commerce: Definition, e-commerce v/s traditional commerce, E- Com vs. E-Business, Framework of E-Commerce: The Information Superhighway, Multimedia Content and Network Publishing, Messaging and Information Distribution, Services Infrastructure. E-Commerce Models.

Unit-2
Securing Business on Network: Web Security issues related to e-business, e-commerce threats: Communication channel ,Secrecy threats, Web server threats, Security by Digital Signatures.

Unit-3
E-Payment Methods : Elements involved in Electronic Payment Systems, Brick and Mortar: Payment Authorization and Settlement, Smart Cards and its types, Credit Cards, Security Issuesin Electronic Payment Systems.

Unit-4
Different e-Transactions: EDI- Definitions, EDI-Layered Architecture, Advantages & Limitations of EDI, Firewalls: Packet Filtering, Application Level Firewalls, Transaction Security: Active and Passive attacks, Fabrication, Interruption , Interception, Modification.

Unit-5
WAP and WWW : WAP technology and its benefits, WAP Protocol Suit: WDP,WTP,WSP,WTLS, Comparison between WWW and Wireless Application Protocol, WWW based security schemes.

Unit-6
Mobile Commerce and Security Issues : Overview, Framework of M-Commerce:, Introductionof Home Banking, Security issues related to Online Banking.

Text and Reference Books
1. Frontiers of Electronic Commerce- Ravi Kalakota & Whinston, 10th edition, Pearson.
2. Electronic Commerce-Bharat Bhaskar, IInd Edition, TMH.
3. E-business- Daniel Amor, Ist, Pearson
4. Electronic Commerce- Turban & Lee, Ist, Pearson
5. Electronic Commerce- Ravi Kalakota & Whinston, VIIth edition, Pearson.

Course Outcomes:

After completing the course, students will be able to:

1. Analyze the impact of E-commerce on business models and strategy
2. Describe Internet trading relationships including Business to Consumer, Business-to-Business, Intra-organizational.
3. Describe the infrastructure for E-commerce
4. Describe the key features of Internet, Intranets and Extranets and explain how they relate to each other.
5. Discuss legal issues and privacy in E-Commerce
6. Assess electronic payment systems
7. Recognize and discuss global E-commerce issues

BCA615 (DSE2): Data &Network Security	
Teaching Scheme	**Examination Scheme**
Lectures: 5 hrs/Week	Class Test -20Marks
Tutorials: 1 hr/Week	Teachers Assessment - 10Marks Attendance – 20 Marks
Credits: 6	End Semester Exam – 100 marks

Prerequisite: - C Programming, Computer Networking.

Course Objectives:

1- To define cryptography, its use, areas where cryptography is needed.

2- To understand security concepts, Ethics in Network Security, security threats, and the security services.

3- To develop code to implement a cryptographic algorithm using any programming language.

4- To analyze all key less and keyed algorithms to identify their strength and weaknesses and try to solve and remove the limitations or optimize the complexity of algorithm(s).

5- To test different available algorithms in terms of complexity, response time, key size, data size, security assurance, etc.

6- To design an algorithmic solution of a problem either by applying existing algorithms or a new one. Identify and classify computer and security threats and develop a security model to prevent, detect and recover from attacks.

Detailed Syllabus:

Unit-1 **Introduction to Cryptography:** Introduction To Security Attacks, Services & Mechanisms, And Conventional Encryption: Classical Techniques, cryptanalytic attacks.
Unit-2 **Private Key Encryption:** Modern Techniques: Simplified DES, Block Cipher Principles, DES Standard, Double DES, Triples DES.
Unit-3 **Public Key Encryption:** Public-Key Cryptography: Principles of Public-Key Cryptosystems, RSA Algorithm, public key distribution, symmetric key distribution using asymmetric cryptosystem.
Unit-4 **Hash Functions:** Message Authentication & Hash Functions, Authentication Functions, Message Authentication Codes (MAC), Secure Hash Algorithm (SHA), Digital Signatures.
Unit-5 **Application Layer Security:** Electronic Mail Security, Pretty Good Privacy (PGP). **Transport Layer Security:** Secure Socket Layer & Transport Layer Security. **Network Layer Security:** Authentication Header, Encapsulating Security Payloads.
Unit – 6 **Network and System Security:** Authentication Applications-Kerberos X.509, Secure Electronic Transaction (Set), System Security: Intruders, Viruses, Firewall Design Principles.
Text and Reference Books 1. Cryptography and Network Security: Principles and Practice, William Stallings, Prentice Hall, New Jersey, 4th Edition. 2. Introduction to cryptography, Johannes A. Buchmann, Springer, Verlag, 2001. 3. Cryptography and Network Security, Atul Kahate, TMH, 2nd Edition. 4. Cryptography, Forouzan, TMH, 2007.

Course Outcomes:

After completing the course, students will be able to:

1.	Identify some of the factors driving the need for network security.
2.	Identify and classify particular examples of attacks.
3.	Define the terms vulnerability, threat and attack.
4.	Identify physical points of vulnerability in simple networks.
5.	Compare and contrast symmetric and asymmetric encryption systems and their vulnerability to attack, and explain the characteristics of hybrid systems.

Program Name- **ADVANCE ARTIFICIAL INTELLIGENCE**
Program Hours- **50**
Tentative Credit – **4**

OBJECTIVES

- To introduce the concepts of Computer Vision & Natural Language Processing that can be designed to solve problems.
- To review the different stages of development of the AI field to establish human like behavior using Computer Vision & NLP.
- To impart basic proficiency in representing difficult real-life problems in a state space representation to solve them using AI techniques.
- To introduce advanced topics of AI such as planning, computer vision, natural language processing and Cognitive Computing.

OUTCOMES

- Analyze and formalize the problem as a state space, graph, design heuristics and select amongst different searches.
- Develop intelligent algorithms for constraint satisfaction problems and design intelligent systems for Industrial Manufacturing Processes.
- Attain the capability to represent various real life problem domains using logic-based techniques and use this to perform inference or planning.
- Formulate and solve problems with uncertain information using CV & NLP techniques.

SCOPE

- AI Developer and AI Analyst
- Data Scientist

PROJECTS

- Chatbot
- Test recognition
- Face Recognition
- Object Detection
- Object Tracking

ADVANCE ARTIFICIAL INTELLIGENCE

Module 1:

AI Learning mechanisms – 4: Active learning, Reinforcement learning, **Computer Vision – Object Detection** – Data annotation and analysis, Algorithms – 1, Algorithms – 2, Algorithms – 3, Algorithms – 4, Other algorithms, Low code libraries.

Module 2:

Ethical AI: Bias and Fairness, Repeatability and Reproducibility. **Computer Vision - Object Tracking:** Sorting algorithm, Deep Sort Algorithm. **Computer Vision** – Object Segmentation, Semantic Segmentation, Instance Segmentation + Panoptic.

Module 3:

Computer Vision – Advanced: Face recognition, Pose estimation, Text recognition, GANs.

Module 4:

Natural Language Processing - Level 1 work: Data collection and annotation, Data EDA and text preprocessing, Text preprocessing. **NLP – Level 2 work:** Part of speech tagging, Word embedding, Feature extraction & Information extraction. **NLP – Level 3 work:** Text classification and clustering, Text similarity engine, Text sentiment analysis.

Module 5:

NLP – Advanced: Transformers, Sequence to sequence, Famous algorithms in NLP – Bert. **NLP – Application:** Email filters, Text autocorrection, grammar check, and recommendation, Chatbot. **NLP + CV:** Caption generation, Text recognition and translation.

Reference Books & Materials:
- Learn AI with Python
- Starting with Pytorch
- OpenCV – Tutorial
- AI Tutorials
- Natural Language Processing with Python by Steven Bird, Ewan Klein, Edward Loper